RFID BASED MULTIPURPOSE SYSTEM

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ABSTRACT

RFID BASED MULTIPURPOSE SYSTEM

Radio Frequency Identification (RFID) is a technology in which communication takes place between a transponder and RFID scanner by means of radio waves. A transponder has a unique code saved in it which is used to identify the item that is tagged. The transponder is powered up when it comes into the vicinity of the scanner and sends a unique identification code to the reader by backscattering the received signal. This code is recognized by the RFID reader and is sent to the host system for retrieving the required information.

RFID has a wide range of applications. The project is the implementation of two major applications of RFID namely Library Management and Parking Management. Automatic issue and return of books as well as protection against theft are the main objectives of Library Management System while authorization and secure entry of personnel and vehicles is a part of Parking Management System.

This technology is widely deployed around the world but in Pakistan, it is not that common mainly because of the fact that it is very expensive and less awareness among the masses. The biggest aim of this project was to design a low cost commercial system.

CERTIFICATE OF CORRECTNESS AND APPROVAL

It is certified that the work contained in this thesis titled “Multipurpose RFID Based System”, carried out by Saad Riaz Qazi, Javeriah Iftikhar Abbasi, Naumana Ayub and Moeed bin Shafiq under the supervision of Asst. Prof. Zaka ul Mustafa in partial fulfillment of the Bachelors of Telecommunication Engineering, is correct and approved.

Approved By

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Project Supervisor

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DEDICATION

Almighty Allah,

Faculty for their help

And our parents for their support

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Nothing happens without the will of Allah Almighty. Special thanks to Allah Almighty for giving us knowledge and strength to accomplish this task successfully.

The team likes to thank our project supervisor, Asst. Prof Zaka Ul Mustafa, without his support and encouragement; it would not have been possible to complete this project.

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TABLE OF CONTENTS

LIST OF FIGURES

Figure No. *Page No.*

LIST OF TABLES

Table No. *Page No.*

LIST OF ABBREVIATIONS

RFID	Radio Frequency Identification
UHF	Ultra High Frequency
HFSS	High Frequency Simulation Software
PIC	Peripheral inline Controller
MHz	Megahertz
RF	Radio Frequency

CHAPTER 1

INTRODUCTION

This chapter will give a brief overview of development and implementation of multipurpose RFID system and its application in library management and parking system.

1.1 Project Definition

The Project aims to equip an institution with automatic RFID systems that can increase overall efficiency and decrease human intervention in most tasks that would otherwise require labor force. Managing, searching, and arranging of books in a library, protection against theft of expensive laboratory equipment, vehicle detection and automated entry system for permitted cars as well as automated attendance system are the aims of this project.

The idea is based on the fact that RFID readers systems are rapidly becoming popular and have been implemented in various environments. It has been predicted that these systems would

completely replace the ‘bar code’ systems till 2030.The primary focus of this system is the design and implementation of a cost-effective system as commercial systems are very expensive and also RFID readers are not locally available.

1.2 Project Survey

In order to develop an RFID system and find its application that can be implemented in the college, the team studied the already implemented RFID based systems in Pakistan as well as aboard. The team carried out market analysis to compare cost of the implemented systems and the necessary features which are required for their efficient operation.

The team chose to implement the system in college library and at entrance gate and conducted few meetings with the college library management and discussed the Bar code reader system which is being used in library. The major drawback in this system is that most of the work has to be done manually and there is no protection against book theft. In order to issue or return books, in present system, a librarian is required all the time to update the database accordingly. Fine calculation for any late submission is also done manually. Similarly the present parking system is also manually operated.

The system automates the library management and parking system in a way such that no human interaction is required throughout the process.

1.3 Project Objectives

1.3.1 Academic Objectives

Academic objectives included the study of communication between RF devices, learningdifferent interfacing techniques, learning and understanding antenna design methods, appropriate coding language for developing desktop applications, learning and establishing a network connection between different systems

1.3.2 Industrial Objectives

Industrial objectives included provision of a cost effective solution for library management and parking system, to bring RFID technology in everyday use in Pakistan and to provide a prototype that can also be used for asset management, security and attendance system.

1.4 Project Scope

This project provides a complete solution for library management and parking system incorporating all the required functions like issue book, return, re-issue, search, reserve, add or delete books, magazines and journals and entry and exit of vehicles etc. It provides remote access to users via an online portal. It has increased the overall efficiency by automating the work which was previous done manually. The same system provides protection against theft by monitoring all books moving in and out of library premises and reading tags on the book. It uses the unique code of tag to search the database to determine whether book being taken out is issued or not.

The same system can be used in other applications, like asset management, parking system, automatic billing system and attendance system, by making changes in the software part of the system. It can also be in track of expensive laboratory equipment by using metallic tags.

1.5 Project Limitation

In order to make the system cost effective, the team has used a single antenna to issue or return books, so it is possible that system fails to

read all the books in bulk and it may skip reading few books. This problem can be solved by using multiple antennas.

To use the same system for different application, the software part needs to be redesigned.

System requires continuous power supply and in case of power breakdown, system has to be configured again.

CHAPTER 2

BACKGROUND

2.1 Overview of RFID

RFID stands for Radio Frequency Identification and this technology has existed for many decades but no one could fathom its usability and wide range of applications during the time it first came into application in World War II. But nowadays it has become one of the hottest supply chain, asset tracking/management and security technology which is rapidly spreading throughout the world.

It is generally said that the origins of RFID technology can be traced back to World War II, where the Germans, Japanese, Americans and British used Radar systems to detect and warn about approaching airplanes. The problem was there was no method of identifying the friendly planes from the enemy planes.

The Germans came up with a crude method in order to identify their own planes which were returning to base. They discovered that if the pilots rolled their planes as they returned to base, it would change the radio signals reflected back. This was the first passive RFID system.

Under Watson-Watt, who headed a secret project, the British developed the first active Identify Friend or Foe (IFF) system. They put a transmitter on each British plane. When it received signals from radar stations on the ground, it began broadcasting a signal back that identified the aircraft as friendly. RFID works on this same basic concept. A signal is sent to a transponder, which wakes up and either reflects back a signal (passive system) or broadcasts a signal (active system).

RFID is a generic term for technologies that use radio waves to automatically identify people or objects. There are several methods of identification, but the most common is to store a serial number that identifies a person or object, and perhaps other information, on a microchip that is attached to an antenna—the chip and the antenna together are called an RFID transponder or an RFID tag. The antenna enables the chip to transmit the identification information to a reader. The reader converts the radio waves reflected back from the RFID tag into digital information that can then be passed on to computers that can make use of it.

The advances and improvements in radar and RF communication systems continued through the 1950s and 1960s. Scientists and

academics in the United States, Europe and Japan did research and presented papers explaining how RF energy could be used to identify objects remotely. Companies began commercializing anti-theft systems that used radio waves to determine whether an item had been paid for or not. Electronic article surveillance tags, which are still used in packaging today, have a 1-bit tag. The bit is either on or off. If someone pays for the item, the bit is turned off, and a person can leave the store. But if the person doesn't pay and tries to walk out of the store, readers at the door detect the tag and sound an alarm.

The RFID technology would make companies and organizations more efficient by enabling real time object tracking, management and automating many tasks that are typically handled manually. The RFID would allow companies, manufacturers and distributors to identify the exact location of their products at any time. Better product prominence will enable the entire supply chain to be more focused on the end customer, producing and shipping goods based on demand and replenishing store shelves with products customers want to buy. Moreover, RFID technology can be effectively used to significantly reduce theft, loss, and time wasted trying to locate and account for valuable equipment.

2.2 Why RFID

RFID is becoming increasingly popular nowadays because of its immense advantages. It has replaced bar codes. The main advantages of RFID are that Reader does not require line-of-sight to read the tag, multiple tags can be read at a time, reader and tag can communicate in any orientation, it provides high security and authentication, it reduces chances of error as there is no human intervention and it is more efficient and saves times as compared to manual system.

2.3 Applications

RFID is widely applicable in the world. Following are the most common applications of RFID.

2.3.1 E-Toll

RFID is now widely being used in electronic toll collection throughout the world. This enables the vehicles to pass through toll plazas without stopping and pay the toll amount automatically which is deducted from the money account of the person in the record as shown in the Figure 2.1. The major advantage of this system queues are minimized at toll booths and vehicles pass through dedicated lanes.

Figure 2.1 E-Toll

2.3.2 Asset Management

Large organizations use RFID for the identification and management of their assets. Computers along with integrated RFID readers are now able to provide such set of tools that eliminate paperwork and also prove identification. This system eliminates manual data entry and also reduces workforce. Companies use RFID based asset management system for locating and monitoring their assets, for recording their current status and for entering items into the database. A handheld reader is used for reading the tags in Figure 2.2

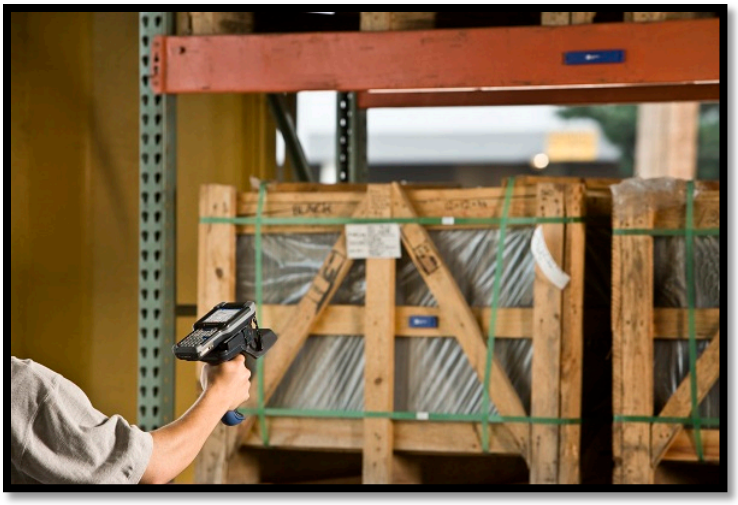

Figure 2.2 Asset Management

2.3.3 Library Management

RFID technology is attracting the library community because of its applications that enhance efficiency and user satisfaction. It enables to keep records of the library items that are issued or reserved and management of shelf items such as books, magazines, journals, CD's and DVD's. Mostly handheld readers are used in the library as shown in the Figure 2.3

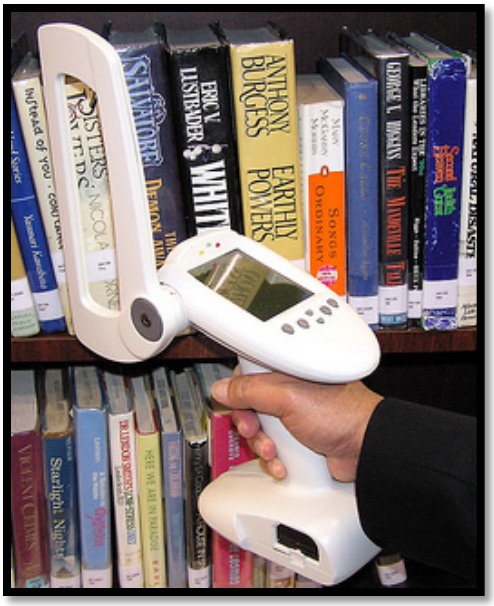

Figure 2.3 Library Management

2.3.4 Event Management

Events such as exhibitions, concerts, sports events, conferences, recreation parks, and trade shows are very difficult to organize. One of the biggest challenges is the secure entry of hundreds of people into the event location. Hence RFID is used to identify, authenticate and register the people, eliminate ticketing system and to reduce costs by reducing workforce as shown in the Figure 2.4

Figure 2.4 Event Management

2.3.5 Attendance System

Many educational institutions and companies have deployed RFID based attendance systems that track attendance and also provide security by preventing unauthorized entry. RFID cards are swapped on a reader for marking the attendance as shown in the Figure 2.5

Figure 2.5 Attendance System

CHAPTER 3

SYSTEM OVERVIEW

3.1 Block Diagram

The system's block diagrams are discussed in the following section.

3.1.1 Library Management System

The RFID based library management system makes use of the multiport capability of the RFID reader in the sense that one antenna is reserved for issuing and returning of the library books and hence it acts as a proximity scanner, the second antenna is used for theft detection and is installed under a platform on which any type of baggage is placed prior to going in or out of the library. The following block diagram would simplify the system's understanding.

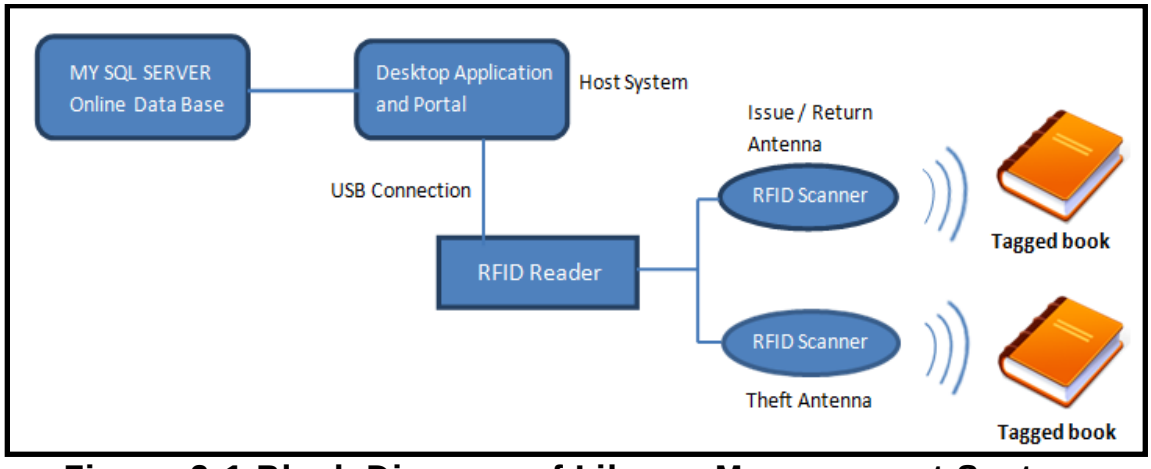

Figure 3.1 Block Diagram of Library Management System

As shown in the block diagram, the system has been divided into three Parts namely the online data base (MySQL), the desktop application running on the host system and the RFID front end.

The online MY SQL Data Base is responsible for hosting information about all the Books, Research papers and other reading material within the library it also contains the student member's information relevant to the activities he/she performs within the library. The Online Data Base is linked with the desktop application running on the host system and is updated in real time.

The Desktop application, developed in visual C#, runs on the host system and provides a platform for the user to interact with the online data base as well as the RFID system. The application hence acts as a bridge between the hardware and software sides.

As depicted in the block diagram, the desktop application controls the behavior of the RFID front end which contains the RFID reader, the two RFID scanners / antennas and the RFID tags on the books. The two antennas perform different functions as explained before and are set up in accordance to their functionality and are connected to the same RFID reader. If a student has to issue a book, he/she will simply place the book on the proximity antenna, followed by his own RFID

student card. After confirmation the book would be issued to the student and the issue bit corresponding to the book would be set so that the theft antenna allows the movement of the book in and out of the library. If the issue bit is not set, the theft antenna would detect and alert the library staff of an unauthorized possession of book. Since the theft detection antenna is situated at the main entrance gate, the probability of theft of a library book is decreased considerably as the Library entrance is continuously monitored.

3.1.2 Automated Parking System

This is the second application that is based on the RFID system and it increases the efficiency and security of the Parking management system considerably, not to mention the significant decrease in the work force as the system would be fully automated. The following block diagram shows the functioning of the system.

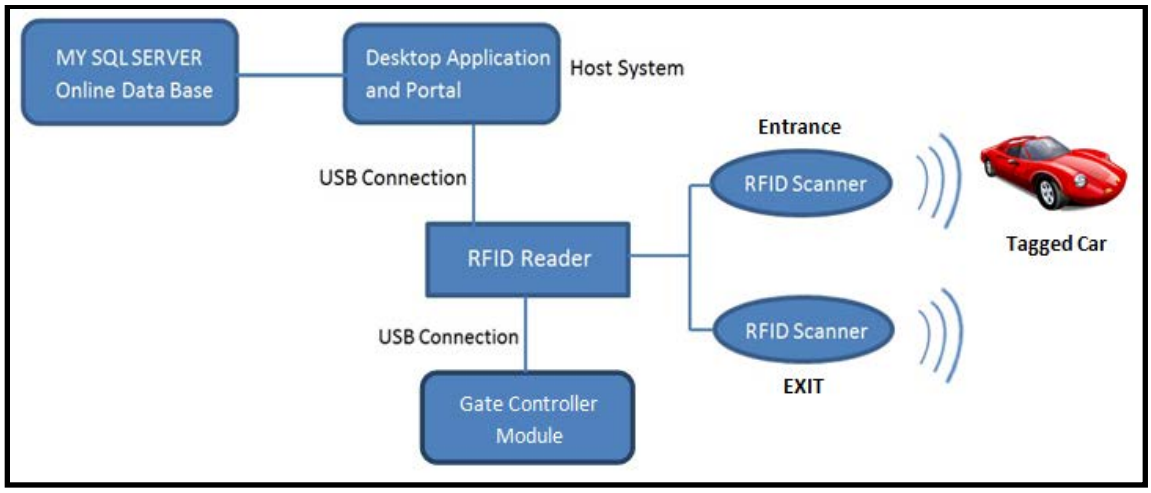

Figure 3.2 Block Diagram of Parking System

The system is similar to the previously explained library management system except for the external RFID antennas. The two RFID antennas would act as scanners for authorized personnel who wish to enter or exit a particular facility and would be installed on both sides of the barrier.This system would also have a dedicated database of all the registered people who are permitted in a facility along with their vehicles.

If a person intends to enter a facility, he would show his card to the RFID scanner located near the gate and the tag of his vehicle is also identified, the RFID reader reads and sends the EPCs to the host system where the EPCs are compared corresponding to their entries in the database and which confirm whether the person is permitted or not. If the person is registered and authenticated the desktop application would activate the microcontroller module connected to the

host system and the automatic barrier would open for a short duration.

The microcontroller module is responsible for the automated control of the mechanical barrier and receives its commands via USB connection to the host system. Manual operations are also included in the module if in special cases, authentication is not required.

3.2 Hardware Used

3.2.1 RFID Tags

RFID tags are also called transponders since they act as both transmitters and responders. An RFID tag is a microchip combined with an antenna in a compact package, the packaging is structured to allow the RFID tag to be attached to an object to be tracked or identified. The Tag's antenna picks up the RF signals from the reader and it retransmits or backscatters the RF signals along with some extra data like, unique serial number or data that is stored in its memory fields. The tags have an internal memory which in most models can be accessed and written to if required, the remaining tags are read only which only transmit their serial number. The RFID tags are normally

very small so that they can easily be attached to items or objects that need to be tracked. RFID tags are of various types depending upon the nature of application and the specifications required e.g. special tags that can work around water and metals etc.

There are two basic types and one other type which is a combination of the two, they are as follows:

3.2.1.1 Passive tags

Passive RFID tags have no internal power supply. Instead, a small electric current is created in the antenna when an incoming signal from an RFID reader reaches it. This current provides enough power to briefly activate the tag, usually just long enough to relay simple information, such as an ID number or product name. Because passive RFID tags do not contain a power supply, they can be very small in size, sometimes thinner than a piece of paper. These tags are low cost and can be activated from a distance of ten millimeters to over 6 meters away.

3.2.1.2 Active tags

Active RFID tags are typically larger and more expensive to produce, since they require a power source. Active RFID tags broadcast their signal to the reader, and are typically more reliable and accurate than passive RFID tags. Since active RFID tags have a stronger signal, they are more adept for environments that make it hard to transmit other types of tags, such as under water, or from farther away.

3.2.1.3 Semi-passive tags

Semi-passive tags resemble active tags in the sense that they have an internal power supply but they do not always broadcast RF signals, instead they transmit signals only after the reader signal is received first.

According to the specifications, the team needed RFID tags that were of low cost, supported UHF frequencies around 900 MHz and also supported the ISO-18000-6c standard. The tags needed to be of such dimensions that they could easily be attached to the books in the library and would not be prominent to anyone. Since the Library Management System required a Database of the books and user, it

was mandatory for the tags to have internal memory to which the user had access and could be written with the information of the item being tagged. For this purpose the team selected the NFC-964[3] passive RFID tags as shown in Figure 3.3which suited the requirements. The details about the tag are given below.

3.2.1.4 Features of Tags

General purpose Squiggle inlay achieves exceptional performance in multiple applications, including but are not limited to, corrugate cases, pallet placards, apparel hang tags, baggage tags, shipping labels, asset management and file folder labels.

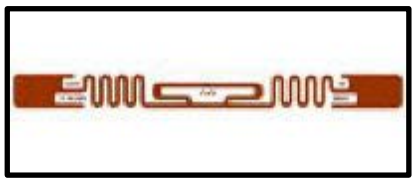

Figure 3.3 Paper Tag

Some of the main features of the tags that have been used are; world Tag with global operation between 860 - 960MHz, EPC global Class 1 Gen 2 (version 1.2.0) compliant ,ISO-18000-6C compliant and antenna dimensions of 95mm x 8.2mm.

Powered by the industry leading Higgs-3 IC boasting a total of 800 bits of memory, including a 32-bit unalterable TID, a 64-bit unalterable Unique TID (UTID) for counterfeit and authentication purposes, a 96-bit EPC memory bank extensible to 480-bits, a 512-bit User memory bank, access and Kill passwords, supports all mandatory and optional Gen 2 commands and custom commands including provisions to hide data from unintended viewers.

From the above technical specifications, it is clear that the tag would be able to store the tagged item's information which in this case may be the book title, serial number, author or any other field unique to the tagged book. This information is relayed to the RFID reader when it comes into the read range of the reader.

For the parking system the team also made use of PVC RFID cards which would be the student ID cards. These tags also supported the same frequency and standards as the nfc-964 tags. These RFID cards would be beneficial since they would make the student / vehicle identification and data entry much more efficient. The read range of these RFID tags is more as compared to the NFC-964 passive tags. In-order to further increase the read range of the parking system, passive tags specially meant for vehicle tagging can be used along with an RF

amplifier to boost the RF field of the RFID scanner connected to the reader.

3.2.2 Antenna

Antenna is a metallic device which is capable of converting electrical energy into electromagnetic energy and vice versa. It is used for both transmission and reception of electromagnetic signals. Antenna is the interface between the free space and guided medium. Mostly antennas are supplied power using coaxial cable.

There are various types of antenna namely wire antennas, aperture and microstrip antennas. Microstrip antenna consists of patch with substrate below it. There are two main configuration of microstrip patch, rectangular and circular patch. Square patch is variation of rectangular patch. Microstrip antennas have low profile, light weight and are easy fabricated.

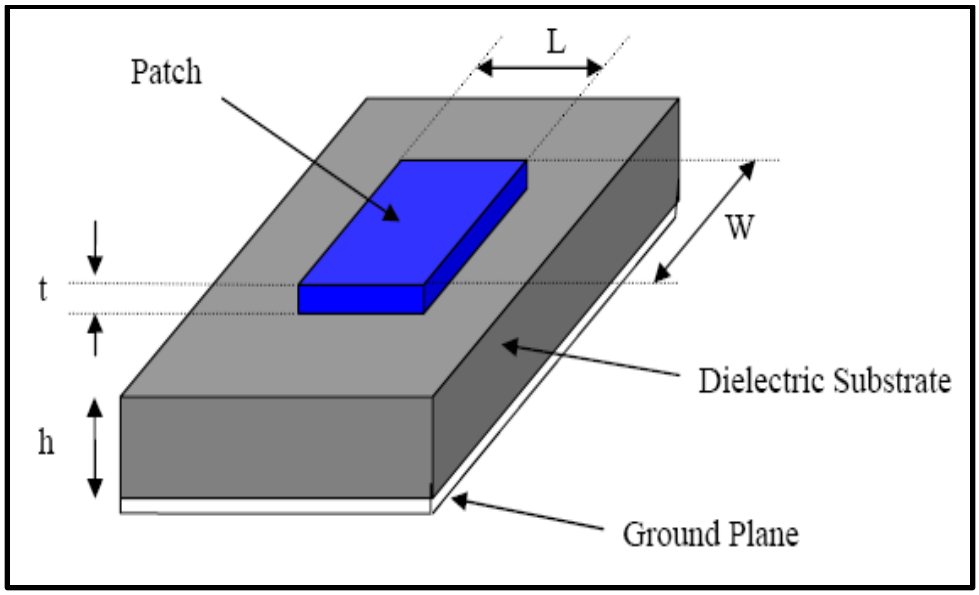

Figure 3.4 Patch Antenna

In the Figure 3.4, L is the width of the patch; t is the thickness of the patch above the surface of substrate. W and h is the length and height of substrate respectively. The lower surface of substrate is ground.

For microstrip patch antenna, thickness of the patch $t<<\lambda$, where λ is the wavelength at which antenna is be designed. Height of the substrate $h<<\lambda$ and usually lies in range $0.003\lambda \leq h \leq 0.005\lambda$. Dielectric constant of the substrate is between $2.2 \leq \varepsilon \leq 12$.

Patch antenna is provided power through coaxial cable. In order to match impedance of coaxial cable with that of patch, a feed line is inserted. The impedance is coaxial cable is either 50Ω or 75Ω.

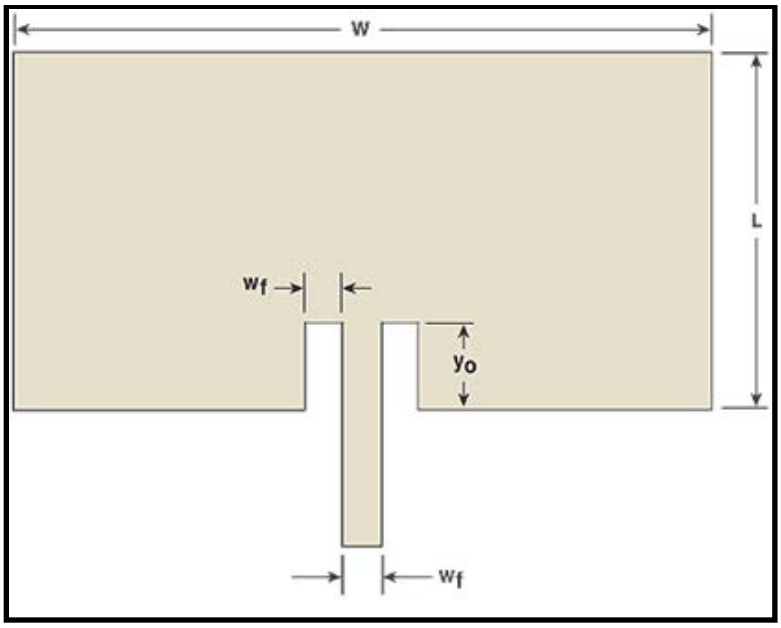

Figure 3.5 Basic Parameters of Patch Antenna

In the Figure 3.5, W is the length and L is the width of the patch, whereas W_O is the width of the microstrip feed line and Y_O is the distance to the point where the impedance of patch and microstrip line matches.

3.2.2.1 Polarization

Polarization is the orientation or direction of electrical field in space. It specifies the pattern of EM waves radiated by the antenna. In case of receiving antenna, it is direction of the wave which results in providing maximum power across the antenna.

There are three main classification of polarization, linear, circular and elliptical. Actually linear and circular polarizations are variations of elliptical polarization and are obtained when ellipse becomes a straight line and circle. The direction of electric field is taken either clockwise or anticlockwise. Clockwise rotation is termed as right hand polarization and anticlockwise as left hand polarization.

3.2.2.1.1 Linear Polarization

Electric field is linearly polarized if it is oriented along a straight line in space. This is achieved if electric field has only one component or two orthogonal components that have same phase or are 180º out of phase.

3.2.2.1.2 Circular Polarization

Electric field is circularly polarized if the field has tow orthogonal linear components that are equal in magnitude but have 90º or odd multiple of 90º phase difference. The field is either right hand polarized or left hand depending upon the rotation of field in space.

3.2.2.2 Circularly Polarized Antenna

Linearly polarized antenna can radiates energy in either vertical or horizontal direction but not in both. In order to radiate energy in all directions and receive signals from the transmitting antenna placed in any orientation, a circularly antenna is required. A simple patch antenna can be made to radiate circularly by exciting two orthogonal linearly polarized modes with phase difference of 90º. (IEEE paper)

Circularly polarized antenna reduces the multipath loss, has low profile, and is small in size and light in weight.

3.2.2.3 Parameters of Antenna

Some of the most important parameters of an antenna are discussed below:

3.2.2.3.1 Gain

Gain of an antenna is a key performance factor. It is defined as the ratio of the power produced by an antenna to the power produced by an isotropic antenna. For a transmitting antenna, the gain specifies how well the transmitting antenna converts input power into electromagnetic waves in a specific direction. For a receiving antenna, it specifies that how well the receiving antenna converts received

electromagnetic waves into electrical power. Radiation pattern is a plot of gain as a function of direction.

Gain of an antenna can be positive or negative. When a dimension of a square patch antenna is greater than 0.28λ, it is as an electrically large antenna and it will have a gain greater than one (positive gain in dB). When the dimension is less than 0.28λ, it is called an electrically small antenna and its gain will be less than one (negative gain in dB). In this case, the dimensions of the patch are 58x58mm which is less than 0.28λ; hence negative gain (in dB) is obtained.

3.2.2.3.2 Axial Ratio

Axial ratio is the ratio of the major axis to the minor axis of the ellipse which is polarized. It is an important factor for checking whether the polarization is circular or not. A circularly polarized field consists of two orthogonal E-field components of equal amplitude and 90^{o} out of phase. As the two components are equal in magnitude, hence the axial ratio of a circularly polarized wave is 0 dB (1).

3.2.2.3.3 Reflection Coefficient (S11)

S-parameter or scattering parameters use the reflected and transmitted signals to describe input output relationship of a two port network. S11 is the ratio of reflected voltage to incident voltage at the antenna. It tells how much power is reflected back from the antenna and how much is transmitted.

3.2.2.3.4 Characteristic Impedance of Antenna (Z_O)

It is the ratio of voltage and current at the input of the antenna. It is either 50Ω or 75Ω. In order for the RFID reader to create a RF coverage area to interrogate and identify tags, it requires an antenna which is responsible for the transmission and reception of the RF signals.

Choosing the type of antenna can affect the overall read range of the reader and so it must be done carefully. In this system, the team required a long read range at the theft detection and parking authentication end and so the team looked up an antenna that could detect any tag within a range of 2-4 meters, in any orientation and operated in the 900MHz frequency range

3.2.3 RFID Reader

The RFID reader also known as an interrogator is the heart of all RFID systems as it is the device that transmits the RF signals and thus interrogates the RFID tags in its vicinity, the tags respond with their unique ID to the reader when they are within the range of the reader's antenna. The medium for interrogation is wireless and the distance is normally limited and due to this reason there is no line of sight required between the tags and the reader. The reader's RF system can send instructions to the tag to read or write the memory in the tag.

The RFID reader has an RF module which is responsible for the transmission and reception of the Radio Frequency signals. The transmitter consists of an oscillator to create the carrier frequency, a modulator to impinge data upon this carrier signal and an amplifier to boost the signal enough to awaken the tag. The receiver has a demodulator to extract the received data and also contains an amplifier to strengthen the signal for processing. A microprocessor forms the control unit, which employs an operating system andmemory to filter and store the data. This data can now be accessed by an appropriate interface between the host system and the reader.

A number of factors can affect the distance at which a tag can be read (the read range). The frequency used for identification, the antenna gain, the orientation and polarization of the reader antenna and the transponder antenna, as well as the placement of the tag on the object to be identified will all have an impact on the RFID system's read range.

Normally the RFID readers work with only specific kind of tags but now a days, multimode readers are available in the market which can interact with tags of different kinds. Due to the vast application of RFID systems in today's world, it is required that the RFID systems operate on different frequencies meant for different purposes. The frequencies ranges over which the RFID systems typically operate are given in Table 3.1

Frequency	**Comments**
125 – 134 kHz	Low Frequency / Inductive coupling
13.56 MHz	Medium Frequency
400 – 960 MHz	UHF / Backscatter coupling
2.45 GHz	SHF / AVI (Automatic Vehicle Identification)

5.8 GHz	SHF / Backscatter coupling

Table 3.1 Frequency Ranges

The team required a RFID reader that would have the ability to interrogate tags within a range of 2 to 4 meters and would have relatively high read rate and data transfer rate.

The Library Management and Automated Parking System make use of two and one external antennas respectively. For the Library management System one antenna is used as proximity scanner for short range detection for the purpose of issuing/returning and reading student ID tags and the other is a long range theft detection antenna which would be installed on doors to detect the unauthorized movement of the books in and out of the library premises.

For the Parking system, the antenna which is used for theft detection in the library management system can change roles to detection of authenticated users and vehicles allowed in and out of a particular area. For this purpose it was necessary that the reader supported multiple antenna ports. After careful research, the team choose 850 – 940 MHz as the optimum frequency of operation and the ISO 18000-6c

standard for Library System, and in order to support this, the team employed the UHF RFID Reader Module **(NFC-9802M[2]).** This model coped up with the requirements and specifications, not to mention the small size and low cost added to its benefits. The technical details about the reader are given below in Table 3.2

Operating frequency	860MHz~960MHz (Adjustable for local regulation)
RF protocol	ISO18000-6B, EPC Class 1GEN 2, ISO10374 Container Standard
Operating method	Frequency Hopping or fixed frequency (set by software)
Antenna	Connect 2 antennas by SMA connector
Max RF power	30.0dBm
Power smoothness	< 0.5DB
RF power range	20.0~30.0dBm (Adjustable by software)
Identify tag mode	Receive reading command
Identify tag time	< 8ms (Identify single tag)
Reading/Writing tag time	No more than 5ms every 8 bytes when reading, 25ms every 4 bytes when writing
Reading distance	12dBi antenna: 0~12 meters

	9dBi antenna: 0~6 meters 7dBi antenna: 0~4 meters Also dependent on the tag and testing environment
Communication interface	UART (RS232/TTL)
Power consumption	≤ 5W
Product size	109mm*79mm*12.7mm
Packing size	232mm*118mm*63mm
Gross weight	621g
Net weight	50g
Working temperature	-20º C~+70º C(-4º F~+158º F)
Storage temperature	-40º C~+85º C(-40º F~+185º F)
Accessories	Power adapter, Power cable, RS-232 cable

Table 3.2 Features of RFID Reader

An image of the RFID Board used in the project is given in the Figure 3.6

Figure 3.6 RFID Board

The reader interface is UART / RS232 but the team have made use of the RS232 to USB converter in order to make the reader compatible with the newer host systems that do not support the serial port, this would be explained further in the upcoming topics.

When connected to a host system the RFID reader is easily operate able by configuring the host system COM ports and adjusting the reader parameters. Since the reader hosts two antenna ports, it is quite flexible in the sense that the power levels for both the ports are adjustable which can enable variable read range for the two antennas connected to the reader. The team has accessed the reader's operability using the APIs provided with the reader and have integrated the reader system with the software application which is thoroughly discussed in the software portion of this document.

3.2.4 RS232 (Serial) to USB converter

The RFID reader connected with the host system with the help of a RS232 serial interface, which is not always available on many new computer systems. In order to enable the RFID reader to communicate with the host system via USB port, theteam needed a RS232 to USB converter which provides the output through a USB end from the reader. Although the RS232 to USB converter is not suitable for electronic devices that are powered through the RS232 port, the team can afford to use the converter since the power supply to the RFID reader is from an external source and so all that is needed to connect the reader to the computer system is the RS232 to USB serial converter driver that can be either automatically installed as the converter is plugged in or needs to be installed from another source.

3.2.5 Microcontroller Module

The automatic parking system is controlled via the central microcontroller module that is interfaced with the host system to which the RFID system is connected. The module does the job of allowing authenticated personnel to either enter or exit a facility with the help

of an automated mechanical barrier. Further details of the module are explained in following topics.

3.2.5.1 PIC 18F4550 Microcontroller

The brain of the parking system module is the PIC18F4550 microcontroller as shown in the Figure 3.7. It performs all the functions of the parking system, from communicating with the host system to driving the DC motor via the H-Bridge IC, responsible for opening and closing of the mechanical gate.

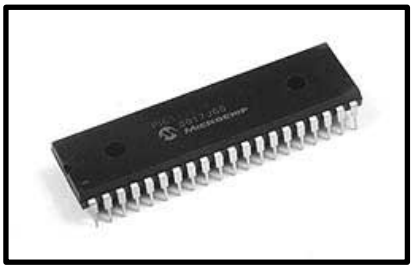

Figure 3.7 PIC 18F4550

The microcontroller has been selected because of USB communication capability and the ease of programming of the controller. Also the flexible library for the PIC18F simplifies the coding and increases the efficiency of the controller. This controller is abundantly available at a relatively low cost and it has a variety of functions which makes it very suitable for the project[4].

3.2.6 L293D / H-Bridge IC

The L293D IC shown in the Figure 3.8 is a motor driver IC that uses the H-Bridge function in order to control the Bi-Directional DC motor. The L293D IC has been interfaced with the PIC18F4550 which controls the external voltage across the output pins of the L293D which in turn drive the motor in the desired direction. Depending upon the voltage on the input pins from the microcontroller, the voltage from an external source can be set across the output pins and hence the polarity can be controlled. The L293D is capable of supporting high power ratings and so it is a crucial component to drive the high power motor of the mechanical barrier[5].

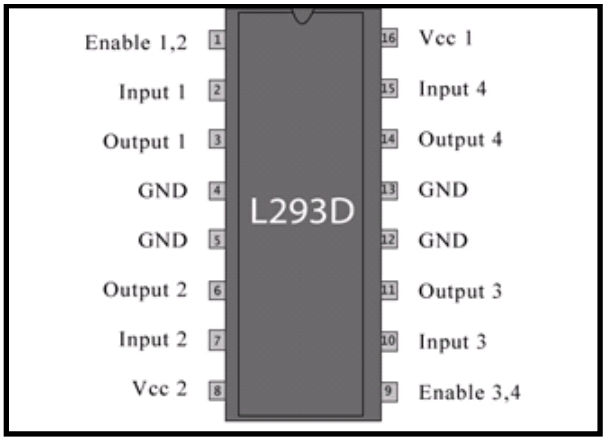

Figure 6.8 H-Bridge IC

3.2.7 USB Interface

The parking system module communicates with the host system to which the RFID components are connected through the USB interface. The team has programmed the PIC18F4550 microcontroller to allow USB interfacing and with minimal hardware components the team have accomplished a stable USB interface that enables us to control the parking system module from a host computer system. Also one added feature is the option of either USB or external powering of the module. When the external power is not connected, the module is powered via USB port from the computer system, and when external power is supplied, the powering shifts to the external.

3.2.7 Mechanical Gate

The mechanical gate is used in the Parking system and consists of the following parts:

3.2.7.1 Bi-Directional 12V DC Motor

In order to move the heavy metallic barrier, a 50W high power Bi-Directional DC motor is employed as shown in the Figure 3.9.It is capable of providing sufficient torque and which can be easily

controlled through the L293D Motor Driver IC. Since the motor's rotational speed was too great, a 50 W, 3.9 ohm metallic resistor was used to slow down the rotations.

Figure 3.9 DC Motor

3.2.7.2 Three Stage Cascaded Gears

In-order to reduce speed and increase the torque, a 3 stage gear cascading is employed as shown in Figure 3.10 and the end rotation was provided with the help of a belt to reduce the strain and damage on the gears if the barrier was loaded too much or was manually obstructed. The gear box was fitted in an aluminum assembly on which the aluminum barrier was mounted.

Figure 3.10 Gears

3.3 Programming Languages

Different languages used in development of the software as well as the hardware are discussed below:

3.3.1 PHP

PHP is a server-side programming language that is used for Web development to form Web pages. It is one of the first scripting languages that can be embedded into HTML source code. It also includes command line interface as well as standalone graphical applications.

3.3.2 C#

It is a programming language that supports different programming paradigms. It consists of various functions and structures and is object-oriented and component-oriented. It was developed by Microsoft as a part of .Net Framework.

3.3.3 C Code and Compiler for Programming PIC Microcontroller

In-order to program the microcontroller that has been used in the parking module, the team used MikroC compiler for PIC because of its vast library of inbuilt functions and its ease of use. The microcontroller employed in the module is performing the three basic functions in the system i.e. establishing serial communication with the host system, controlling the mechanical gate through the L293D motor driver IC and displaying the status of the gate with the help of LEDs.

CHAPTER 4

SYSTEM DESIGN

4.1Hardware Design

The hardware design consists of the following parts and each is discussed in detail in this section.

4.1.1Antenna

RFID antenna is an important part of the project. It helps the RFID IC to communicate with the tagged objects and hence forms an integral part of RFID reader. The team required a circularly polarized antenna for the system. Design of antenna has been taken from an IEEE paper.

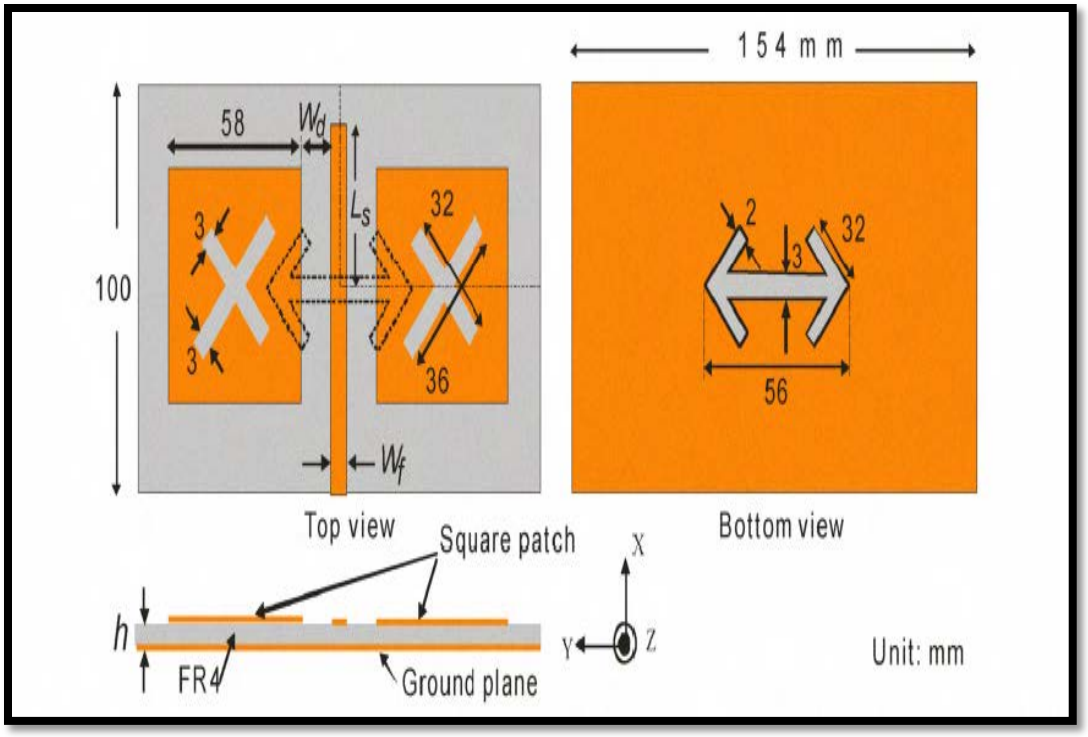

Figure 4.1 Antenna Dimensions

As shown in Figure 4.1, the antenna consists of two square patches of equal length of 58mm printed on upper side of a single FR4 substrate sheet which has thickness of h=1.6mm and relative permittivity of 4.4. A 50Ω microstrip line with a width W_f=3mm is printed on the same plane of the FR4 substrate. The microstrip line is extended beyond the center of the pair of the patches by a length $L_S = \lambda_g/4$ (39mm) for the tuning stub, where λ_g is the feed line wavelength. The tuning stub improves the impedance matching of the antenna[1].

The patches are electromagnetically coupled from the feed line through a gap distance W_d. At the same time, the microstrip feed line

is used to excite the patches through an arrow shaped coupling slot on the other side of the substrate. The dimensions of the slot are specified in the above figure and slot is etched on the ground plane with a length of 154mm and width of 100mm. An unequal length of cross-slot is etched on the square patch and is inclined and is inclined with respect to the arrow shaped coupling slot with an angle of 45º. With the unequal length of cross-slot, the fundamental resonant mode of the square patch can be split into two orthogonal resonant modes with equal amplitudes and a 90º phase difference required for the generation of cross polarization.

The resonant length of the radiating square patch is half the edge length of the cross slot (~74mm), which operates at its fundamental mode and corresponds to about 0.48 guided wavelength of the center frequency (935 MHz). By varying the feed gap (W_d), this provides an effectively capacitive coupling between the microstrip line and square patch radiators and achieves an adjustable axial ratio of the antenna[1].

4.1.1.1 Development of the Antenna

The antenna has been simulated in High Frequency Simulation Software v.11 (HFSS) and results were compared with those given in the paper. The results were almost similar to those given in the paper. The design of the antenna, as seen in HFSS is shown in Figure 4.2 below:

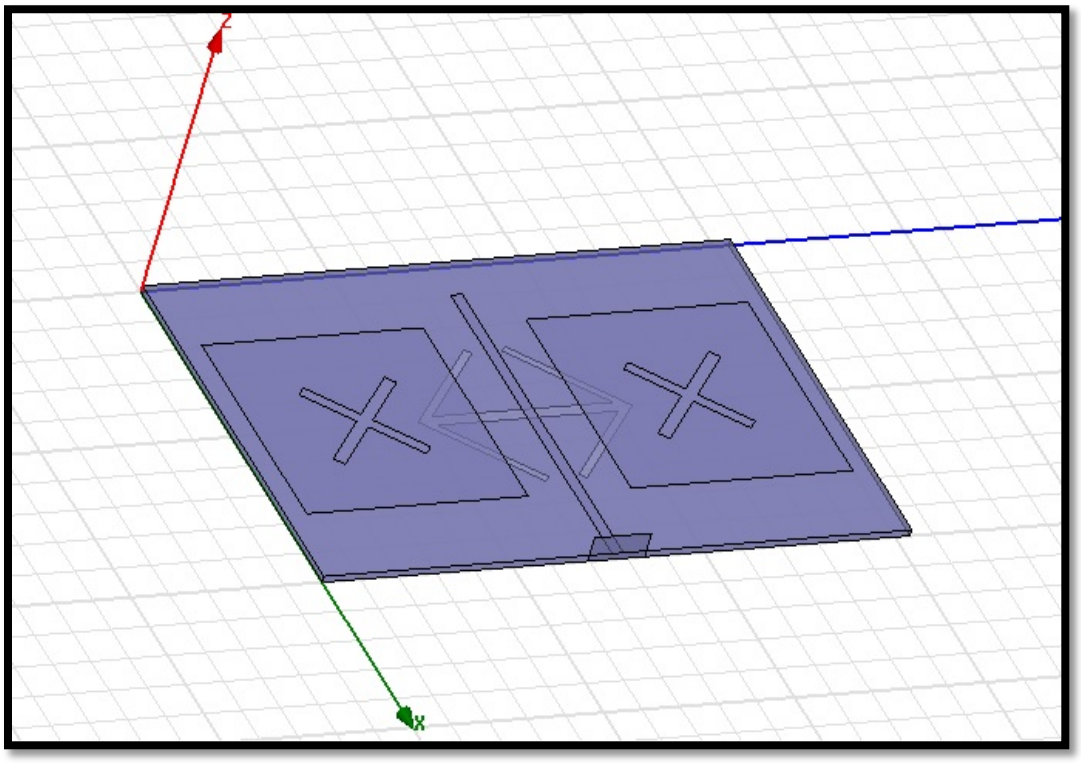

Figure 4.2 HFSS Simulation

4.1.1.2 HFSS Results

The antenna is simulated in HFSS and various parameters are set. Then specific results are obtained and compared with those given in the IEEE paper. These results are as follows:

4.1.1.2.1 S11

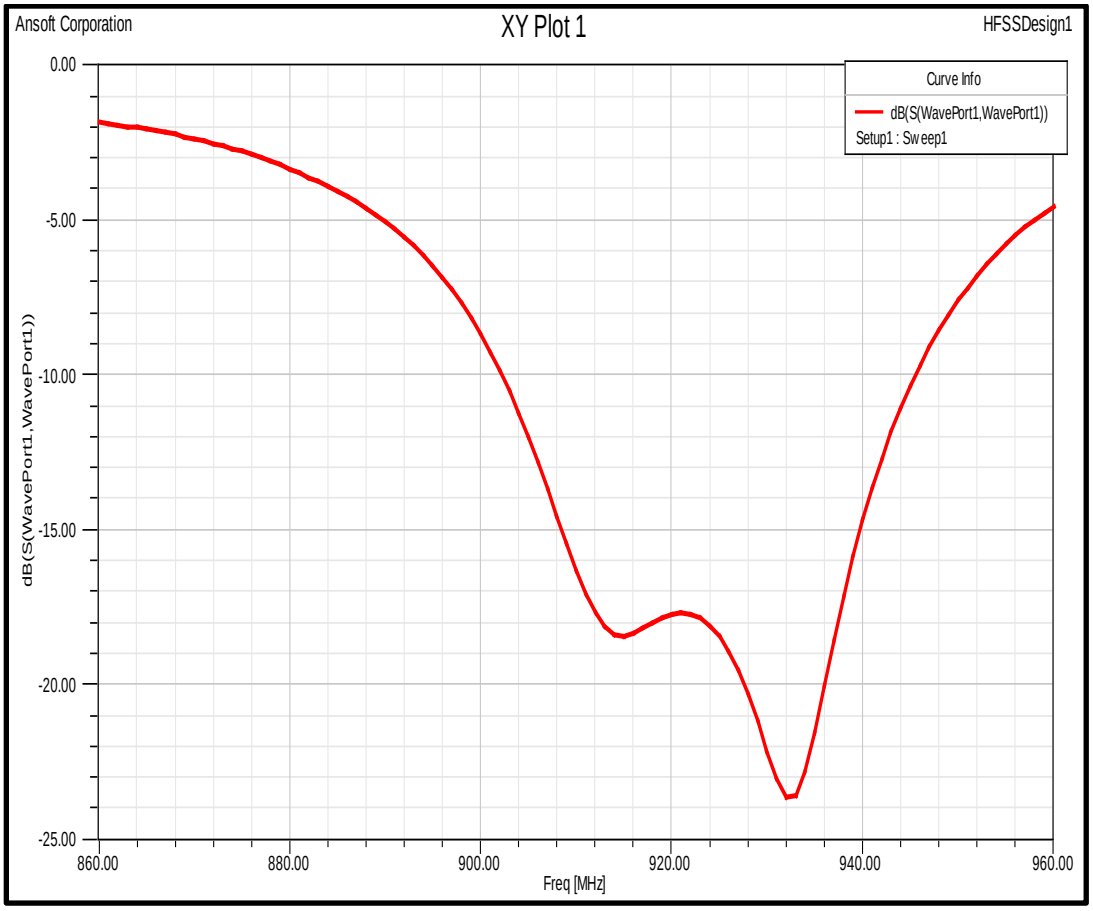

Figure 4.3 S11

The Figure 4.3 shows that antenna works properly at 933MHz. The error of 2MHz is tolerable as the team want the antenna to be

operation between 860MHz to 960MHz. This result is acceptable for us as there is get a good dip of around -28dB.

4.1.1.2.2 VSWR:

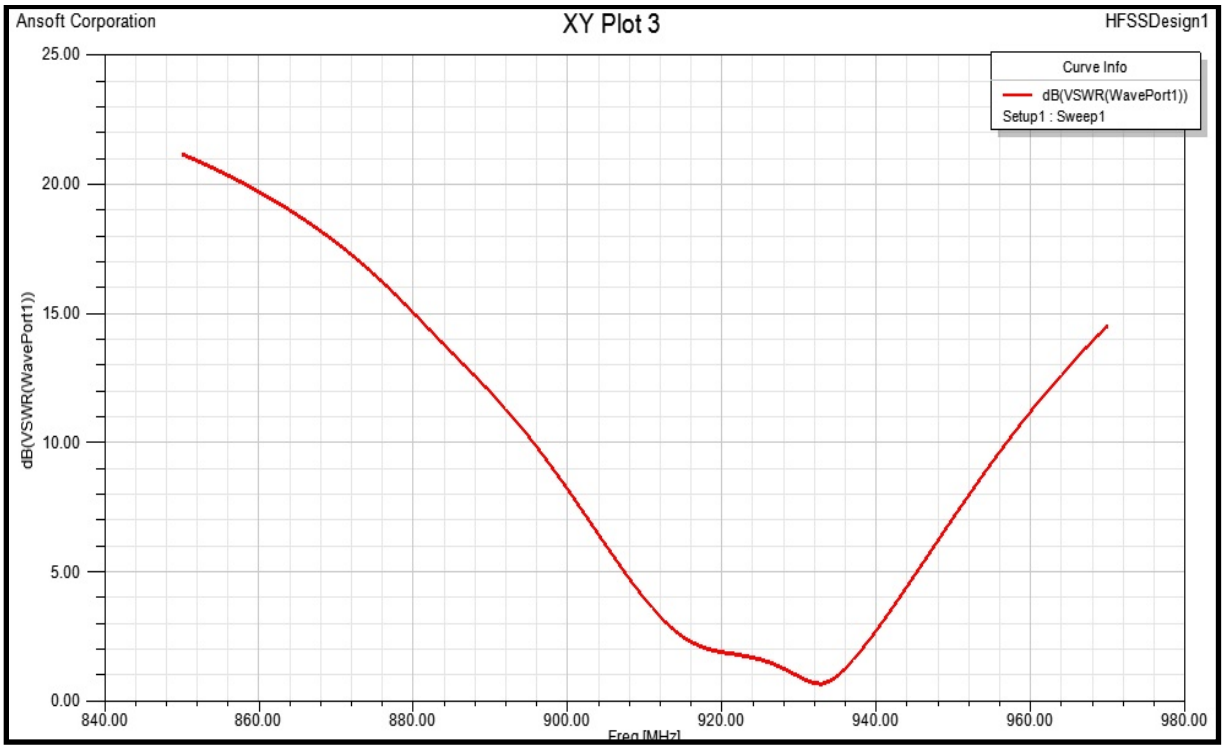

Figure 4.4 VSWR

The Figure 4.4 shows that the voltage standing wave ratio of the antenna also lies within the desired range (1 to 2). Minimum VSWR means that antenna performance will be best at this point.

4.1.1.2.3 Port Impedance Z_o

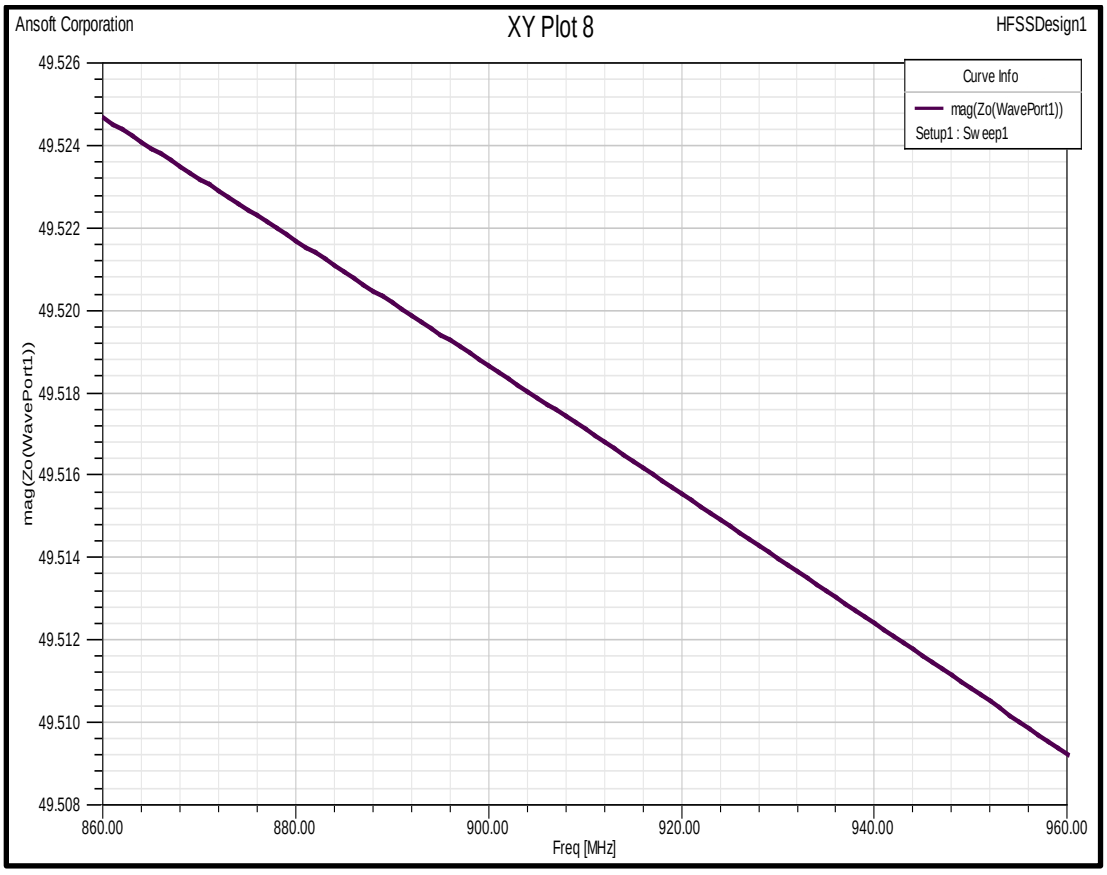

Figure 4.5 Port Impedance

For best operation of antenna, its port impedance should be 50Ω. In the entire range of frequency (860 MHz to 960 MHz) the impedance is approximately 50Ω as shown in the Figure 4.5

4.1.1.2.4 Current distribution Plot:

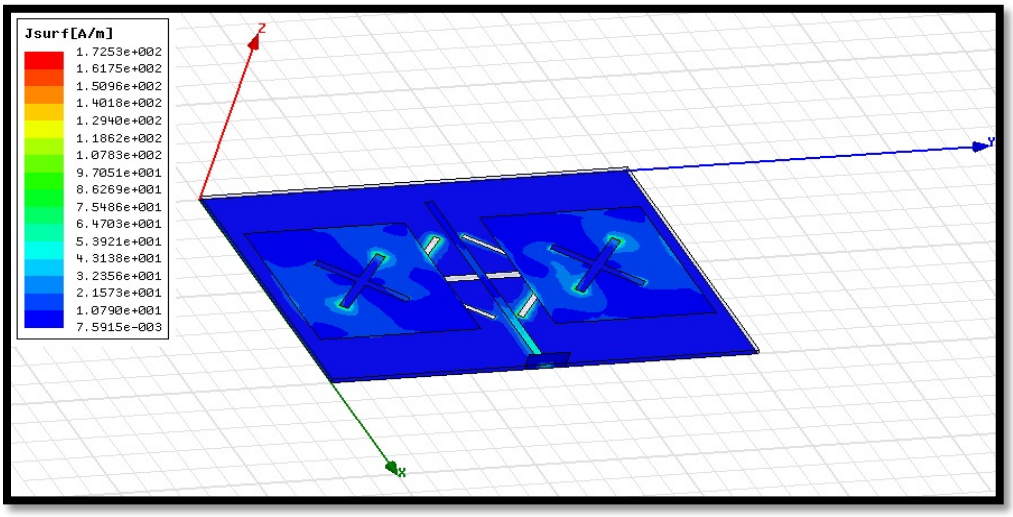

Figure 4.6 Current Distribution

The current distribution plot of the antenna is shown in the Figure 4.6 This shows the current density on the surface of the antenna. The team can see high density near the edges of the slots which show that the pattern is as per the requirement.

4.1.1.2.5 Gain of Antenna

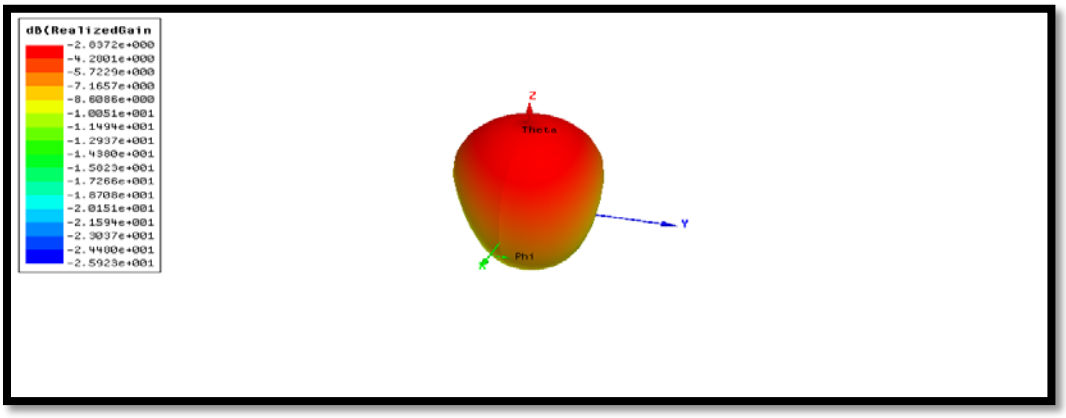

Figure 4.7 Antenna Gain

The Figure 4.7 shows that the gain of the simulated antenna is negative. When the dimension of an antenna is less than 0.28λ (Approximately 1/4λ) it is called an electrically small antenna, the gain is less than one (negative gain when expressed in dB).

4.1.1.2.6 Axial Ratio

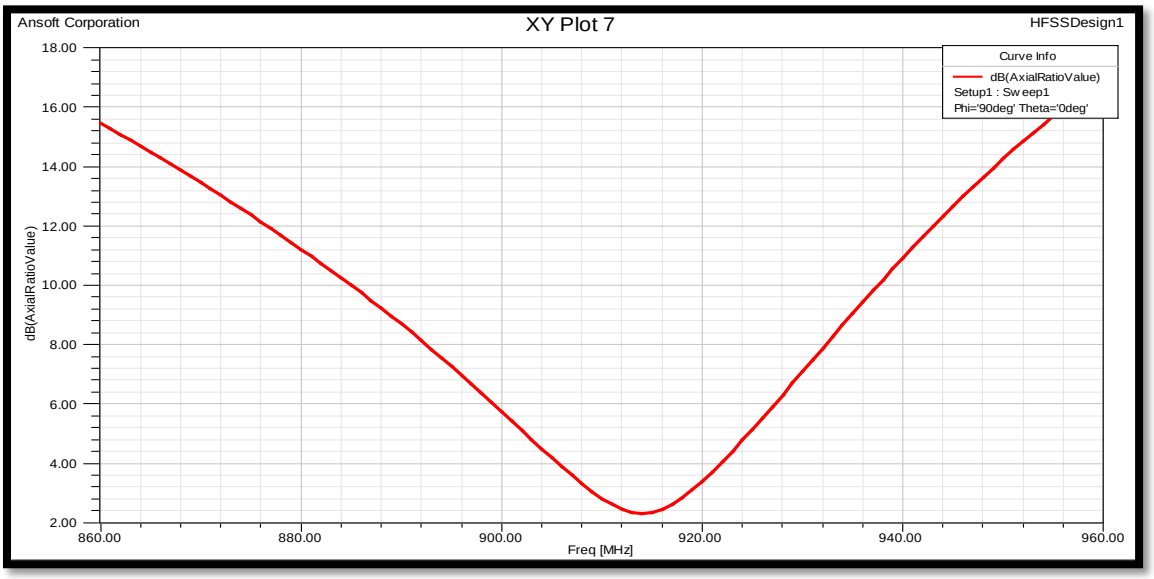

Figure 4.8 Axial Ratio

The axial ratio of the antenna should be less than 10 dB for pure circular polarization. As shown in the Figure 4.8, the axial ration is less than 10 dB in the entire range.

4.1.1.3 Fabrication of Antenna

The antenna is fabricated after obtaining the desired results. The Figure 4.9 and 4.10 show the top and bottom views of the fabricated antennas:

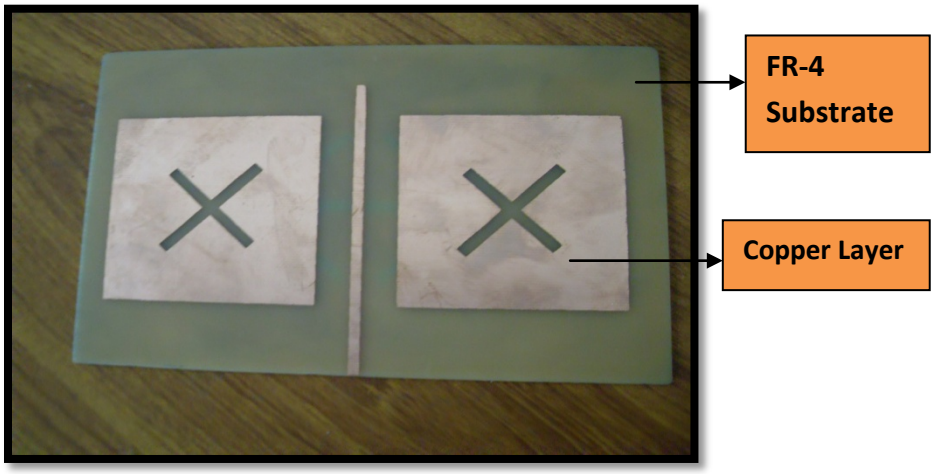

Figure 4.9 Top View of Antenna

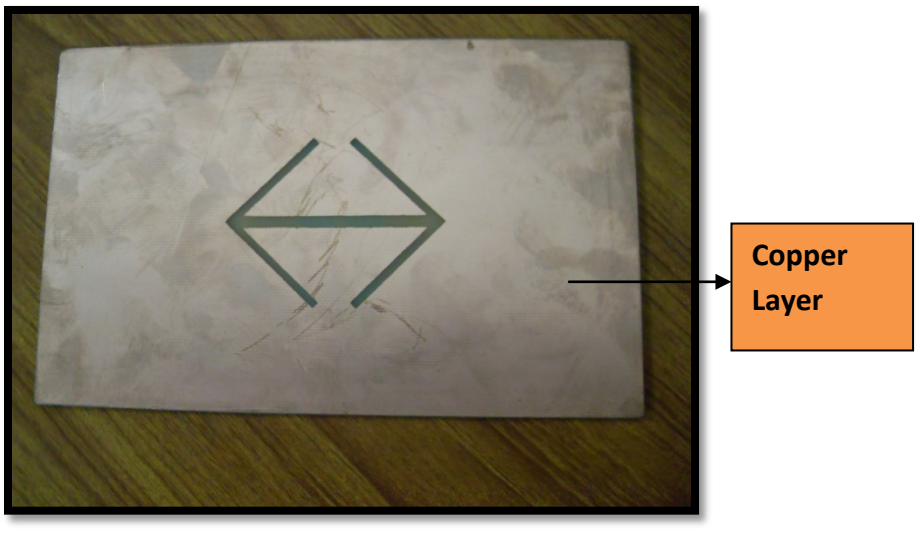

Figure 4.10 Bottom View of Antenna

4.1.2 Schematics and PCB Design of Parking Module

The schematic for the Parking system module is given below in the Figure 4.11:

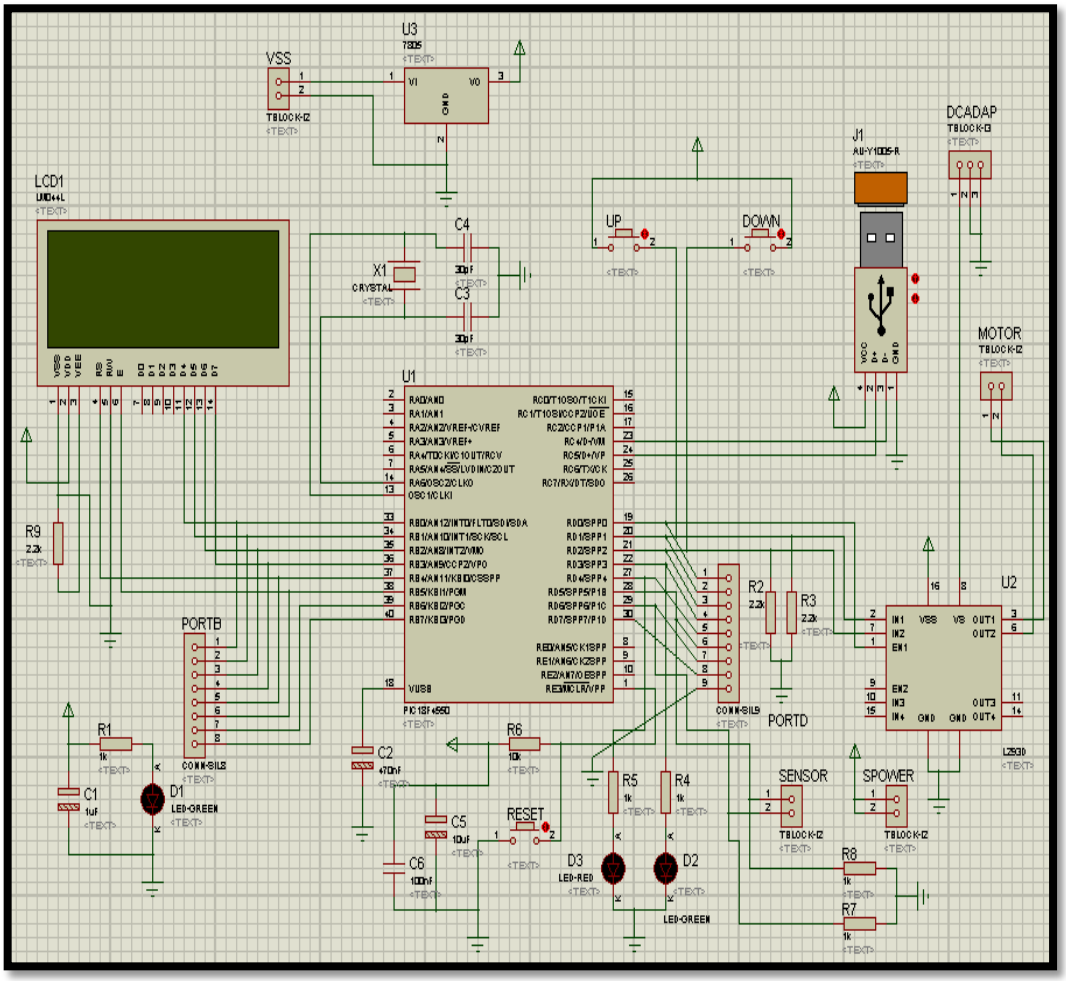

Figure 4.11 Proteus Simulation

4.1.2.1 PCB Trace layout

The PCB layout of the gate controller circuit for the Parking System is shown below in the Figure 4.12:

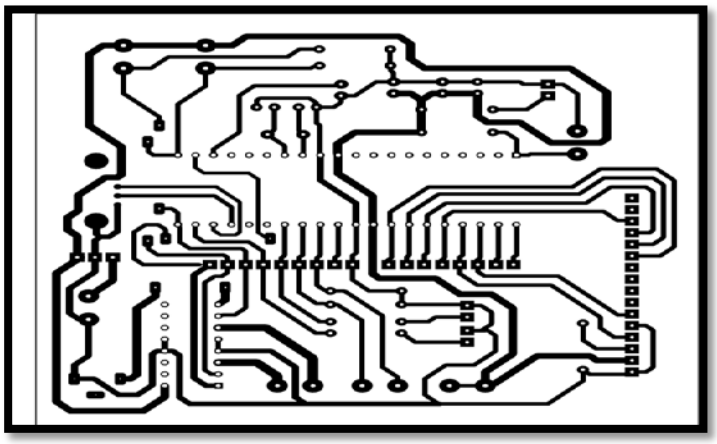

Figure 4.12 PCB Trace Layout

4.1.2.2 PCB Component layout

The PCB layout with the components is shown in the Figure 4.13:

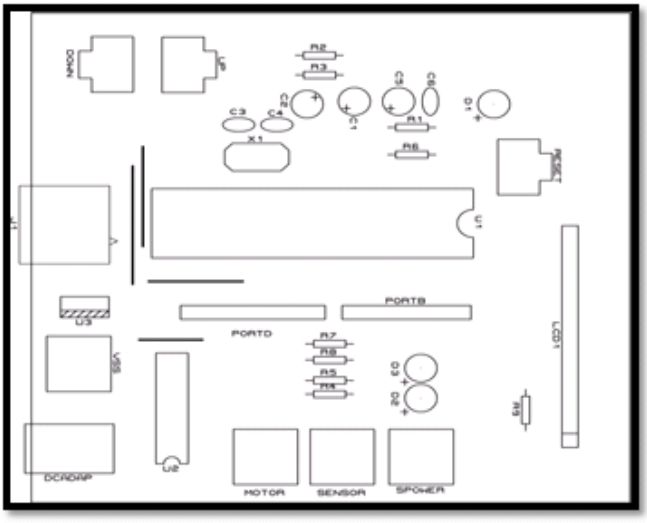

Figure 4.13 PCB Component Layout

4.2 Software Engineering Cycle

The software is developed through a cycle as specified by IEEE. It consists of Requirement Specification, Design Specification, Implementation and Testing.

4.2.1 Software Requirement Specification Document (SRS) for Library Management System

The SRS Document follows a proper format as defined by IEEE. This document specifies the use cases and the requirements of the software to be designed.

4.2.1.1 Introduction

This section includes a brief overview of the purpose and scope of the software and a brief introduction of various terminologies that are used in the SRS document.

4.2.1.1.1 Purpose

The purpose of this document is to present a detailed description of RFID based Library Management System. It will explain the purpose and features of the system, the interfaces of the system, what the system will do, the constraints under which it must operate and how

the system will react to external stimuli. This document is intended for both the administrators and the users of the system.

4.2.1.1.2 Scope

This software is a complete solution for Library management. This system will automate book issuing and returning, will prevent book theft and will provide online access to the digital library. This will be an intelligent system that will minimize human interaction and will increase overall efficiency of the process.The system will not do library shelf management i.e. the books have to be arranged manually in their respective shelves.

More specifically, this system will help the users to search issue and return a book with the help of a database. In addition to this, the system will keep a track of all the books in the library. Once issued, the system will allow the user to take the book out of the library premises. If the user has not issued the book and is trying to take it out, the system will sound an alarm indicating a theft. It will aid the administrator to manage the books and the database via an online portal and will provide the users to search and reserve online. The administrator will no longer have to do continuous monitoring of the

books and will eliminate manual data entry. The software will facilitate the users to search and reserve books online and will be efficient as they would not have to wait in long queues to get the book issued or returned.

4.2.1.1.3 Definitions, Acronyms, and Abbreviations

MySql is a relational database management system (RDBMS) that runs as a server and provides access to multiple users to a number of databases.Desktop Application is a stand-alone application in a desktop or laptop computer. It does not require the Web browser to run.Online Portalis a vehicle by which we can gain access to a number of services. A website is itself a destination. Database is an organized collection of data in digital form.Use Case Diagramis a diagram representing interactions between an actor and a system, to achieve a goal. The actor may be a human or an external system.

Class Diagram is a static structure that defines the structure of a system by representing system's classes, their attributes, operations and the relationships among different classes.ERD is the relationship among different entities of the system in a top-down manner.

4.2.1.1.4 References

IEEE SRS format, Project Specification Requirement by Global Marketplace, www.google.com, www.wikipedia.com

4.2.1.1.5 Overview

The next chapter, the Overall Description section, of this document gives a brief description of the functionality of the product. The third chapter, Requirements Specification section, of this document is written primarily for the users and describes the technical details of the functionality of the product.

These sections of the document describe the same software product but are intended for different users.

4.2.1.2 Overall Description

This section consists of the system diagram, the external hardware and software required in the system.

4.2.1.2.1 Product Perspective

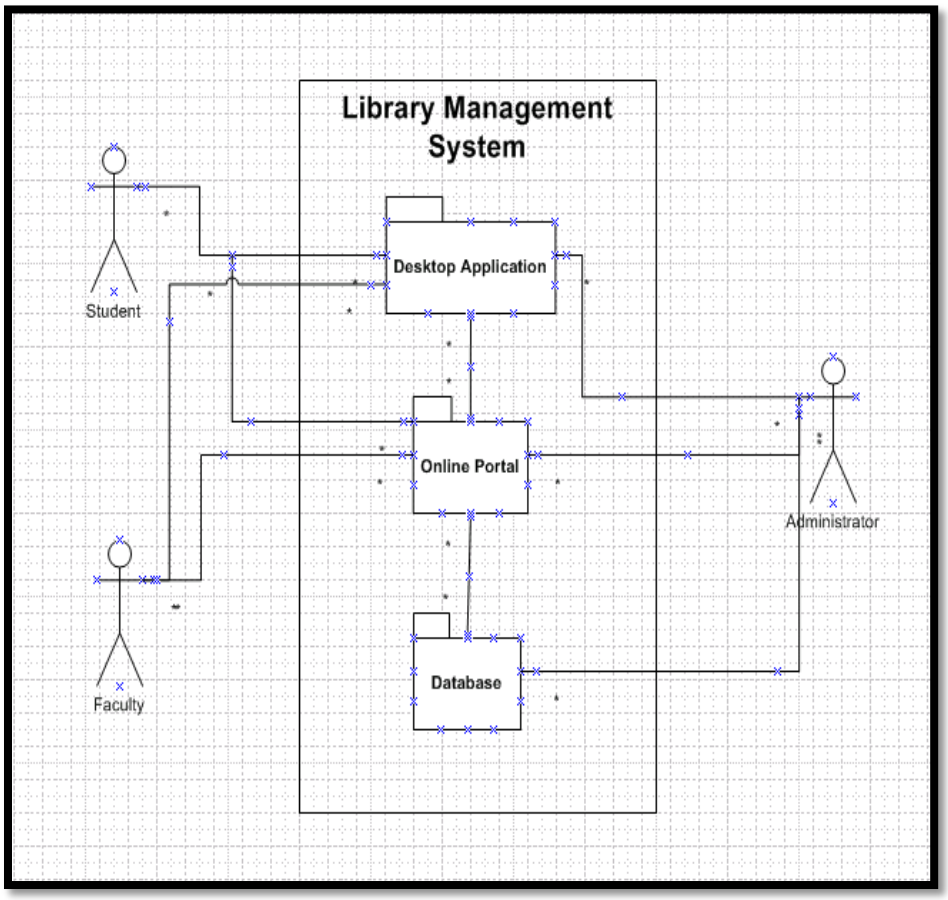

Figure 4.14 System Environment

The library management system consists of two actors and one cooperating system as shown in the Figure 4.14. The actors include the User and the Administrator who can access the system either through the Internet or the Desktop Application. A link also exists to the Database.

4.2.1.2.2 External Hardware

Client Hardware consists of a host workstation and a user workstation. Host Workstation is the computer connected to the RFID reader and is

used by the user or the administrator. User Workstations are the computers used to access the system over the Internet from a remote location.Network used is the Internet which is a global network used by administrators and the users to access the system.

4.2.1.2.3 External Software

Desktop Application which is a software running on the computers for taking input from the user and providing the requested data. It can also be used by the administrator for manual management of the system. Online Portal which is a website used to access the system over the Internet.

4.2.1.2.4 External Systems

Security Gateway is an external antenna (long range) with a server at the backend for protecting against theft of unissued books. Book Management Unit is a small range antenna for reading tags of books to be issued or to be returned.

4.2.1.2.5 User Characteristics

The Student and the administrator are expected to be Internet literate and be able to use a search engine. The administrator is also expected to handle the database and run MySql queries and knowhow of visual studio.

4.2.1.3 Product Functions

This section explains the use cases of the library management system and their details.

4.2.1.3.1 Student/Faculty Use Case System Diagram

Figure 4.15 shows the student or faculty use case diagram. It shows the various ways in which a student or a faculty member can interact with the software system.

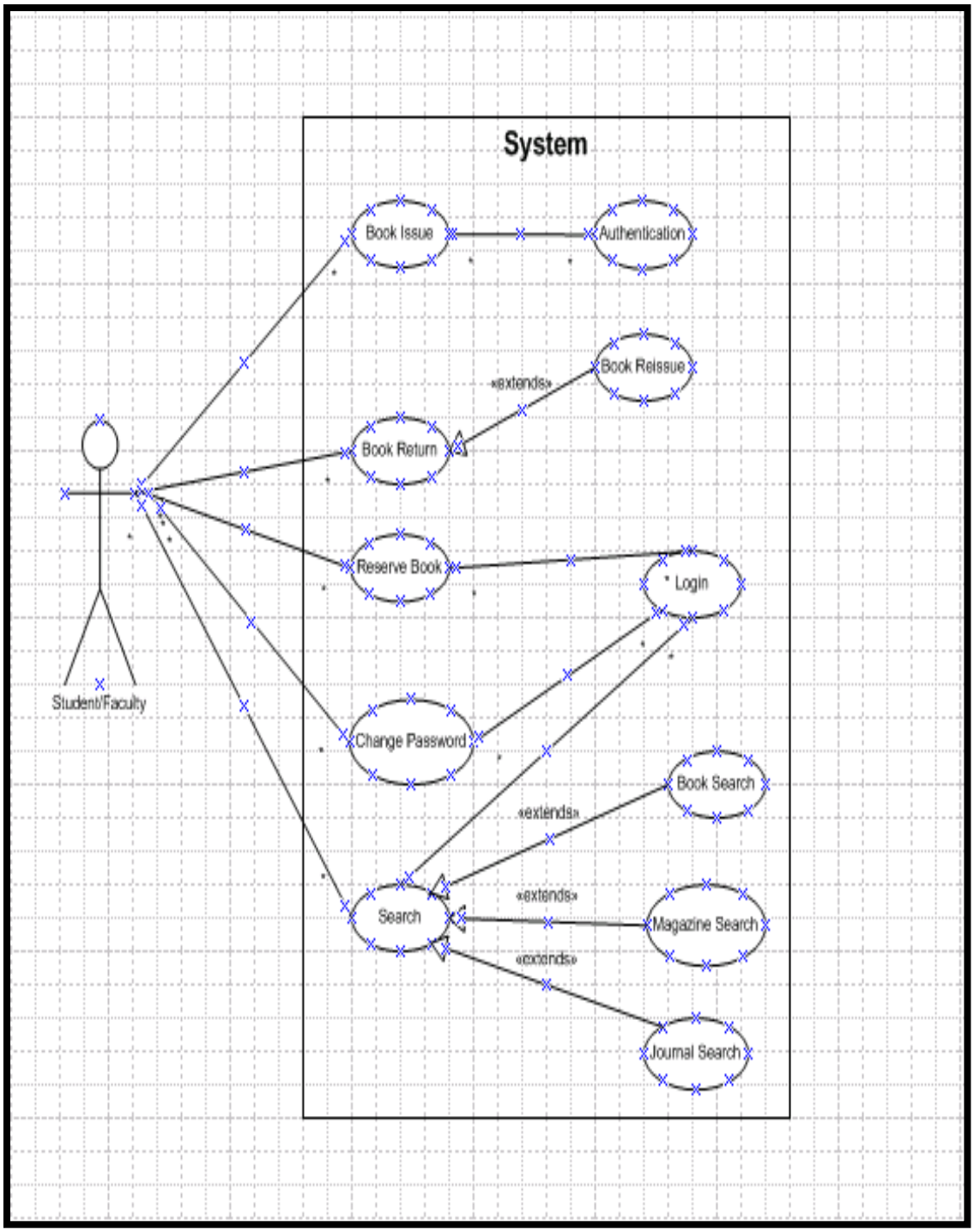

Figure 4.15 Student / Faculty System Use Case Diagram

4.2.1.3.2 Administrator Use Case System Diagram

Figure 4.16 shows the administrator use case diagram. It shows the various ways in which an administrator can interact with the software system.

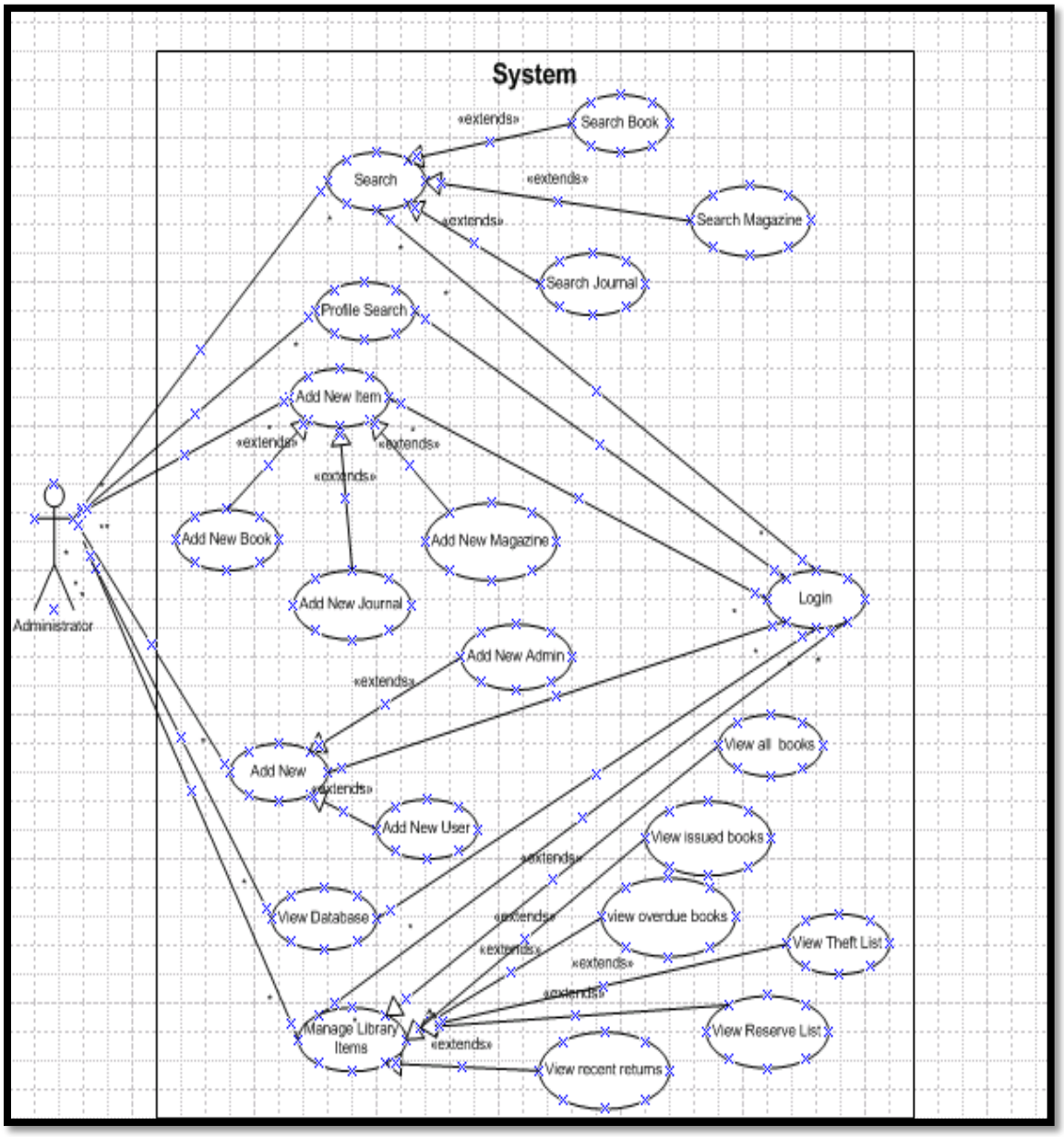

Figure 4.16 Administrator System Use Case Diagram

4.2.1.3 Specific Requirements

These requirements consist of functional as well as non functional requirements which are discussed in detail in this section.

4.2.1.3.1 Functional Requirements

This section explains the use cases for different actors if the system. It specifies the requirements and procedure for executing each use case.

4.2.1.3.1.1 Student/Faculty Use Case

Use cases for student or faculty are discussed in detail in this section along with the diagrams and other details.

Name: Book Issue

Goal

The Student/Faculty aims to save his name against the book name in the database.

Diagram

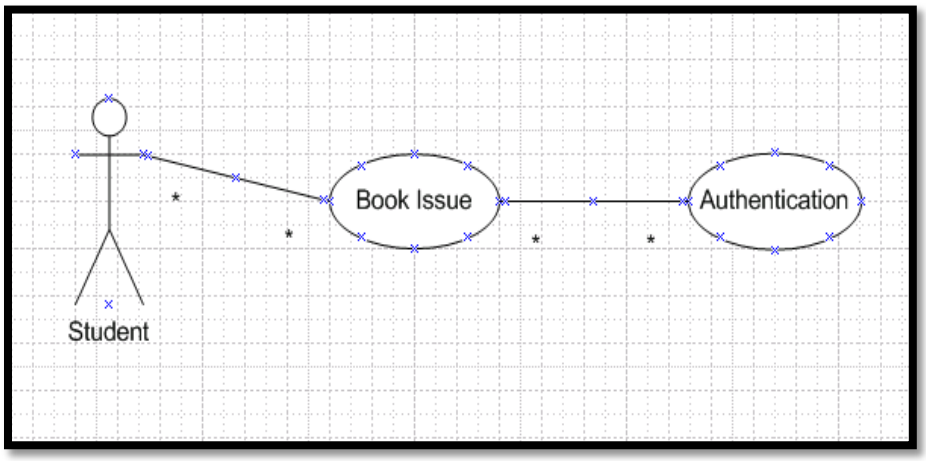

Figure 4.17 Use Case1

Preconditions

The System is turned ON.The antenna is properly integrated with the system.The administrator has logged into the desktop application.

Basic Course

The use case starts when the Student places the student card on the proximity antenna.The antenna reads the tag on the card and sends it to the desktop app.The desktop app checks the Student in the MySql database and prompts a message showing whether the Student has been authenticated or not.If the Student is authenticated, then a message appears to place the book on the antenna within 20 seconds.Student/Faculty places book on the antenna.If done in time,

the database will be updated and certain fields will be set in the database and a message prompts confirming book issue.

Alternate Course

If the student fails to show the book within this time limit, the request will be cancelled and a message appears to place the student card.

User goes to Step 1 again.

Post conditions

Student/Faculty name is entered into the database against the book name.

Actors

Student and Faculty

Name: Book Return/Re-issue via Desktop Application

Goal

The Student/Faculty aims to return the book to the library.

Diagram

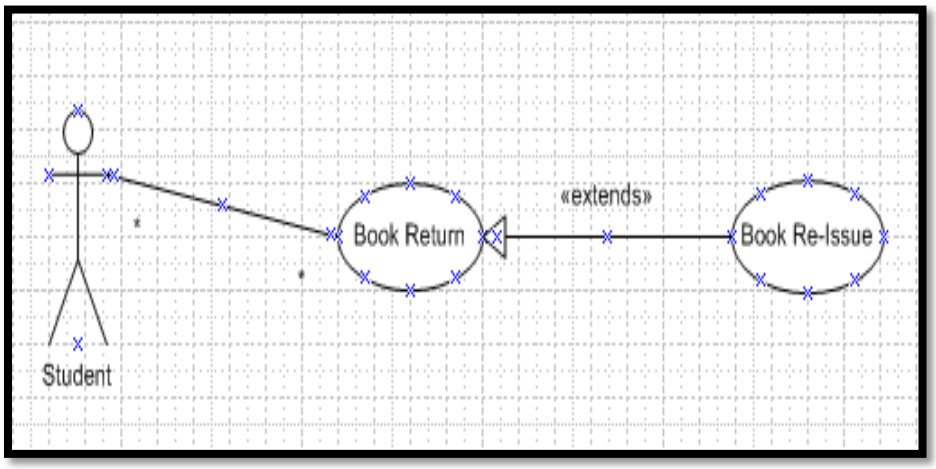

Figure 4.18 Use Case2

Preconditions

The system is turned ON.The proximity antenna is working properly.The administrator has logged into the desktop application.

Basic Course

Use case begins when the Student places the book to be returned on the proximity antenna. System displays a message for student to choose between book return and book re-issue.For book return, desktop application unsets the issue field and updates return date and time in the database and prompts a message to show that return is successful.For book re-issue, desktop application updates date and time in the database.

Alternate Course

If book return or book re-issue is not successful, a message appears to show that the required operation is not successful.

Post conditions

For Book return, the database is updated and the Student name is cleared from the book entry.For Book Re-issue, the database updates the time and date.

Actors

Student and Faculty

Name: Search via Web

Goal

The Student/Faculty wants to search a desired book, journal or magazine.

Diagram

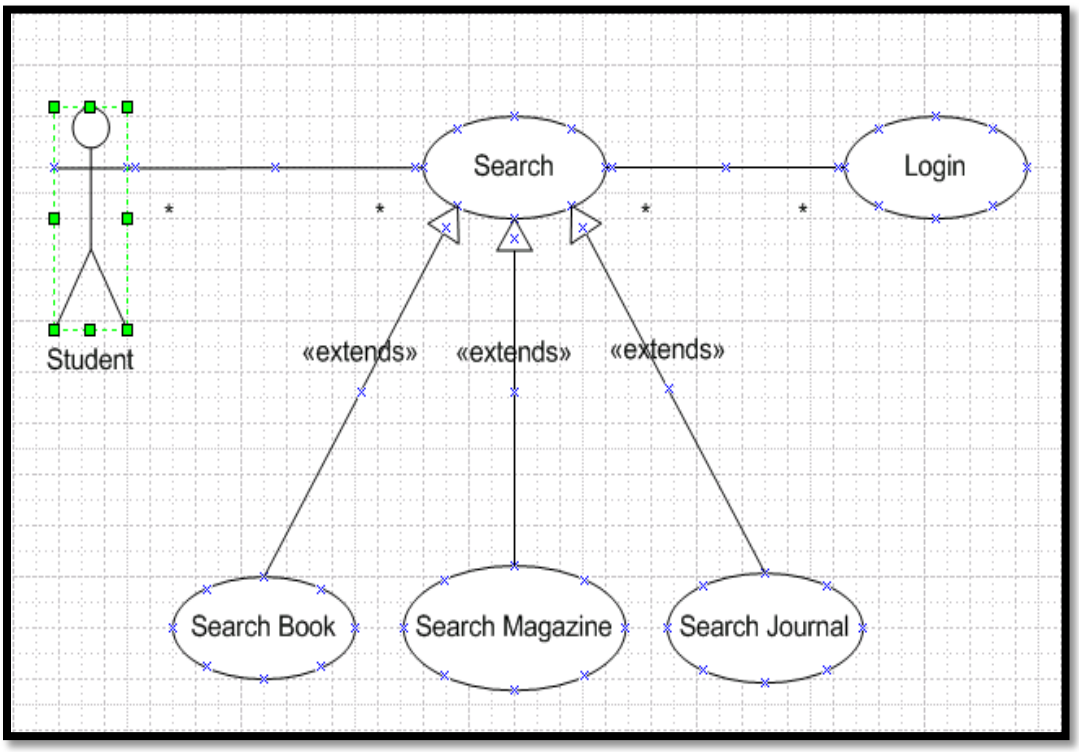

Figure 4.19 Use Case3

Preconditions

The Web is displayed with grids for searching.

Basic Course

The use case begins when the Student accesses the online website.Student/Faculty uses his username and password to log into the system.Student chooses to search by author name, book title, category, keyword and subject.The system displays search results to

student.Use case ends when the Student selects the desired book, magazine or journal.

Alternate Course

If the administrator enters incorrect username or password, a message appears that incorrect username or password is entered and clicks “Forgot Password” if a user has forgotten his password or click “Sign Up” if not already registered.In step 2, if the student/faculty chooses to search by category, a drop down menu appears listing different categories.

Post conditions

Available books appear as a result of the search.

Actors

Student and Faculty

Name: Book Reservation via Web

Goal

Student/Faculty aims to reserve the book against his name in the database.

Diagram

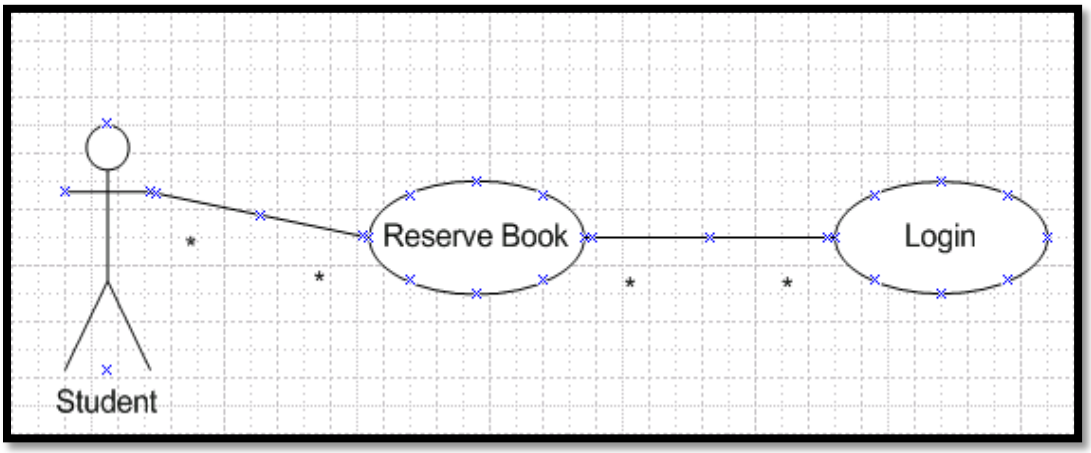

Figure 4.20 Use Case4

Preconditions

The web is displayed with grids for searching.The user is registered and has a valid username and password.The user is logged into the portal.

Basic Course

Use case begins when the Student accesses the online website.Student/Faculty logs in using his/ her username and password.Student/Faculty chooses to search by author name, book title, keyword, category and subject.The system displays search results to student.Student selects the desired book.Student reserves the desired book and is required to get it issued within 24 hours. Three books can be reserved at maximum.Faculty reserves the desired book and is required to get it issued within 2 days. Three books can be

reserved at maximum.Use case ends with the message displayed the system that the book has been reserved.

Alternate Course

If the administrator enters incorrect username or password, a message appears that incorrect username or password is entered and clicks “Forgot Password” if a user has forgotten his password or click “Sign Up” if not already registered.In step 3, a drop down menu appears listing all categories and user returns to step 4.A message appears if the searched book does not exist in the database and the user goes to Step 3.If the user student/Faculty reserves more than three books at a time, then a message appears that you have exceeded the reserve limit.

Post conditions

In database the book will be reserved for the student.

Actors

Student and Faculty

Name: Change Password via Web

Goal

The student/faculty member aims to change the password of his account.

Diagram

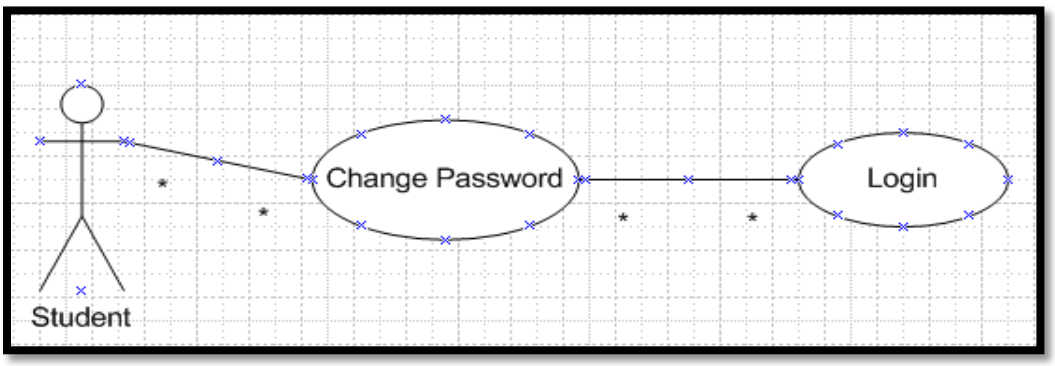

Figure 4.21 Use Case5

Preconditions

The web is displayed with grids for searching.The student/faculty is registered and has a valid username and password.The student/faculty member is logged into the portal.

Basic Course

Use case begins when the Student accesses the online website.Student uses his name and password to login.Student views his profile.Student chooses change password option.Student enters new password and

confirms password by re-entering it.System resets the password.Case ends with the message that password has been changed.

Alternate Course

If the student/faculty enters incorrect username or password, a message appears that incorrect username or password is entered and clicks “Forgot Password” if a user has forgotten his password and if the user has not signed in, then click “Sign Up”. So user goes to Step 2 again. If the user enters incorrect password in confirm password, then a message appears that entered password does not match the original password. So user goes to Step 5 again.

Post conditions

The system displays a message that the password of user has been changed.

Actors

Studentand Faculty

4.2.1.3.1.2 Administrator Use Case

Use cases for the administrator are discussed in detail in this section along with the diagrams and other details.

Name: Add New Item via Web

Goal

The administrator wants to add new books, magazines or journals into the database.

Diagram

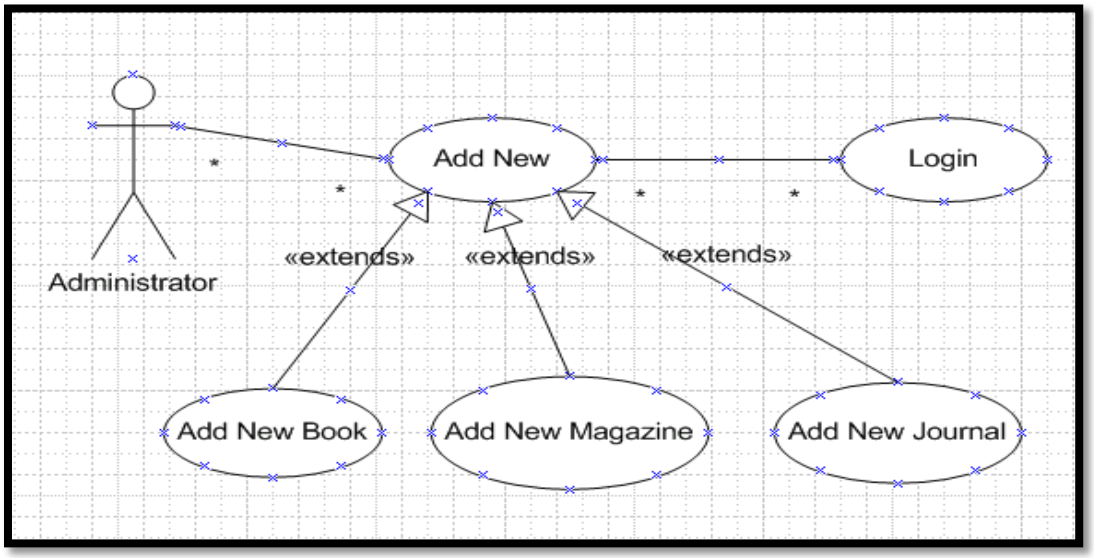

Figure 4.22Use Case6

Preconditions

The Web is displayed with grids for searching.The Administrator has a valid username and password.The Administrator is logged into the web portal.

Basic Course

Use case begins when the Administrator accesses the online portal. User uses his login name and password to log into the system. User adds new by choosing a category from the drop-down menu.Use case ends when new entry is added into the database.

Alternate Course

If the administrator enters incorrect username or password, a message appears that incorrect username or password is entered and clicks “Forgot Password” if a user has forgotten his password. Administrator goes back to Step 2.In step 3, the administrator chooses from the drop down menu to add books, magazines or journals.

Post conditions

The database is updated and a new entry is added into the database.

Actors

Administrator

Name: Profile search via Web Application

Goal

The Administrator aims to view the profile of students in order to check for the issued books

Diagram

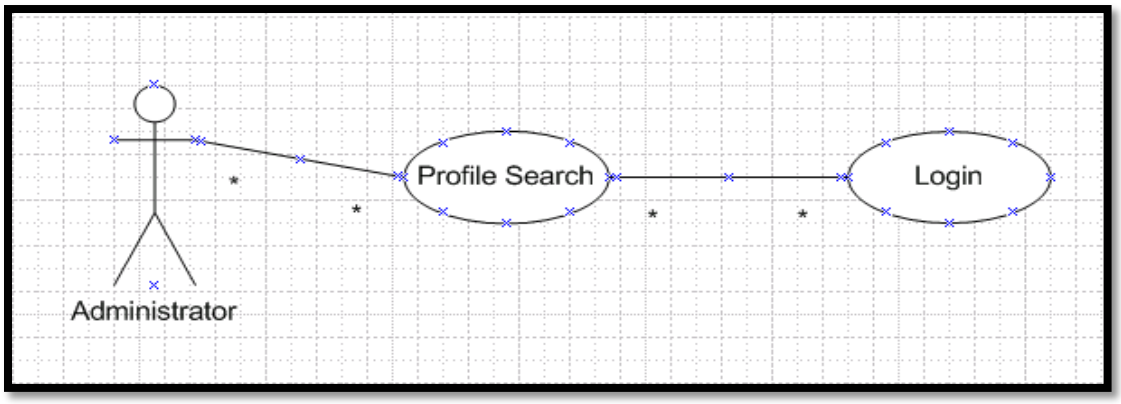

Figure 4.23 Use Case7

Preconditions

The web is displayed with grids for searching.The Administrator has a valid username and password. The Administrator is logged into the web portal.

Basic Course

Use case begins when the Administrator accesses the online portal.Administrator uses his login name and password to log into the system.Administrator chooses profile search option.Use case ends when the profile is displayed by the system.

Alternate Course

If the administrator enters incorrect username or password, a message appears that incorrect username or password is entered and clicks “Forgot Password” if a user has forgotten his password.If the searches student/faculty is not already in the database, then a message appears that “Searched user is not currently registered in the database, click Add New User to add new entry to the database.

Post conditions

The profile of the student/faculty member is displayed by the system.

Actors

Administrator

Name: Search via Web App

Goal

The administrator wants to search a book, magazine or journal to see if it is available in the library and if not available, he can order a new one.

Diagram

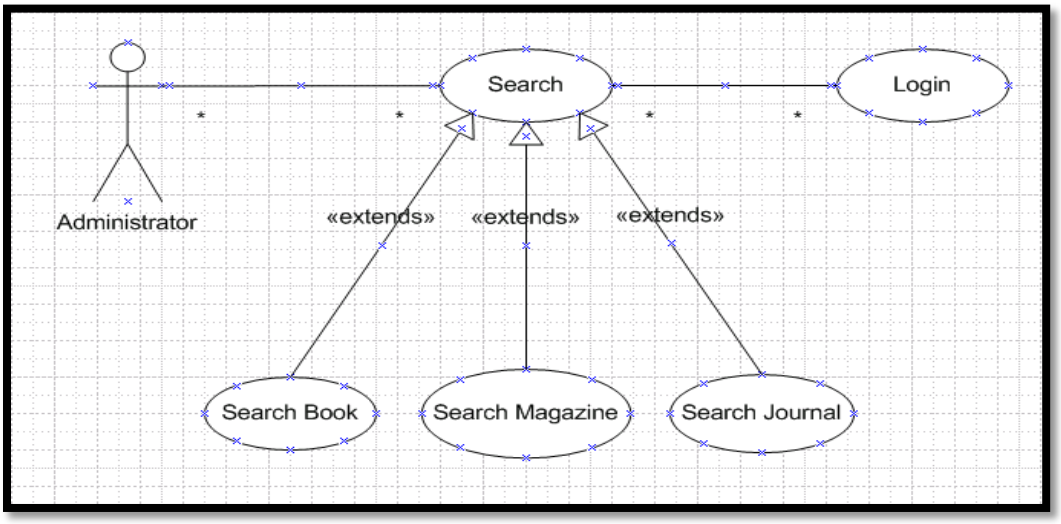

Figure 4.24 Use Case8

Preconditions

The Web is displayed with grids for searching.The Administrator has a valid username and password.The administrator is logged into the web portal.

Basic Course

Use case begins when the Administrator accesses the online website.Administrator uses his login name and password to log into the system.Administrator chooses to search by author name, book title, keyword, category and subject.The system displays search results.

Alternate Course

If the administrator enters incorrect username or password, a message appears that incorrect username or password is entered and clicks “Forgot Password” if a user has forgotten his password.In step 2, if the admin chooses to search by category, a drop down menu appears listing different categories.A message appears if the searched book does not exist in the database and click “Add New” to add new entry to the database.

Post conditions

Search results appear on the screen

Actors

Administrator

Name: Manage Library Items via Web Portal

Goal

The Administrator aims to manage the library items.

Diagram

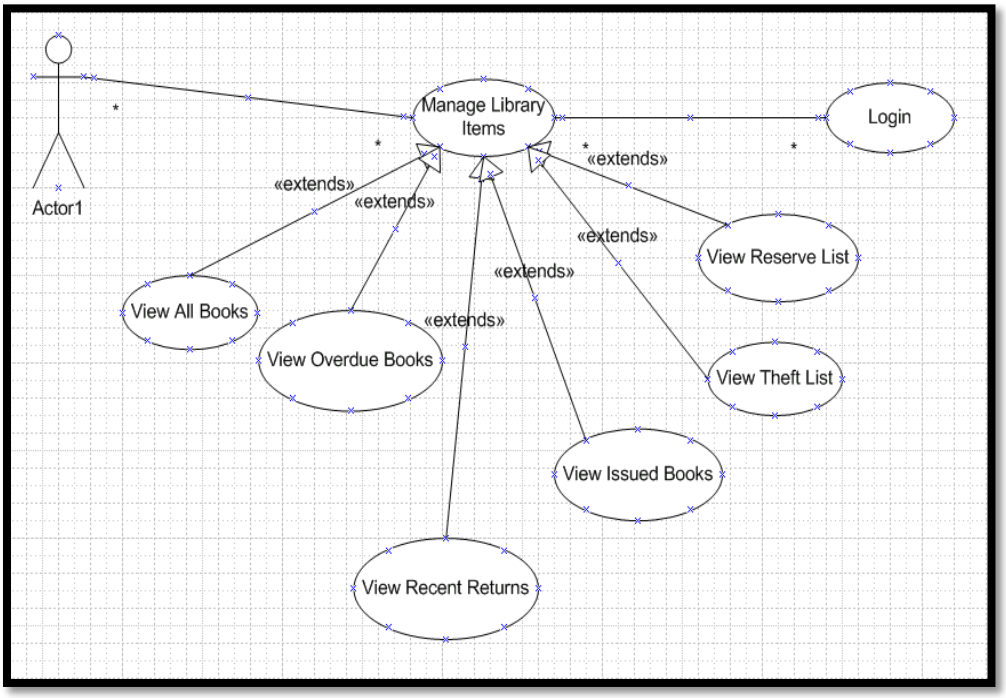

Figure 4.25 Use Case9

Preconditions

The web is displayed with grids for searching.The Administrator has a valid username and password.The Administrator is logged into the web portal.

Basic Course

Use case begins when Administrator accesses the online website.Admin uses his name and password to login.Admin searches by clicking on the manage library items button.Admin can view the list of issued, reserved, recently returned and overdue books as well as the theft list.

Alternate Course

If the administrator enters incorrect username or password, a message appears that incorrect username or password is entered and clicks “Forgot Password” if the administrator has forgotten his password.

Post Conditions

The system displays list of issued, reserved, recently returned and overdue books as well as the theft list.

Actors

Administrator

Name: View Database via web portal

Goal

The administrator wants to edit the database.

Diagram

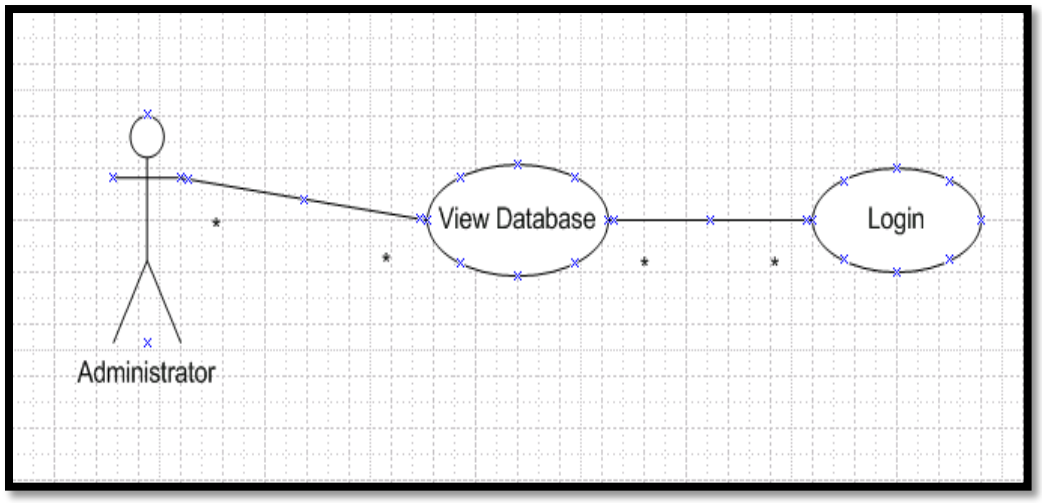

Figure 4.26 Use Case10

Preconditions

The Web is displayed with grids for searching.The Administrator has a valid username and password.The Administrator is logged into the system**.**

Basic Course

Administrator accesses the online website.Admin uses his name and password to login.Admin chooses the view option.Admin can edit certain fields, add or delete books, magazines or journals.

Alternate Course

If the administrator enters incorrect username or password, a message appears that incorrect username or password is entered and clicks “Forgot Password” if the administrator has forgotten his password.

Post conditions

The database is viewed and can be updated.

Actors

Administrator

Name: Add New User/Admin via Web

Goal

The administrator wants to add a new user to the database.

Diagram

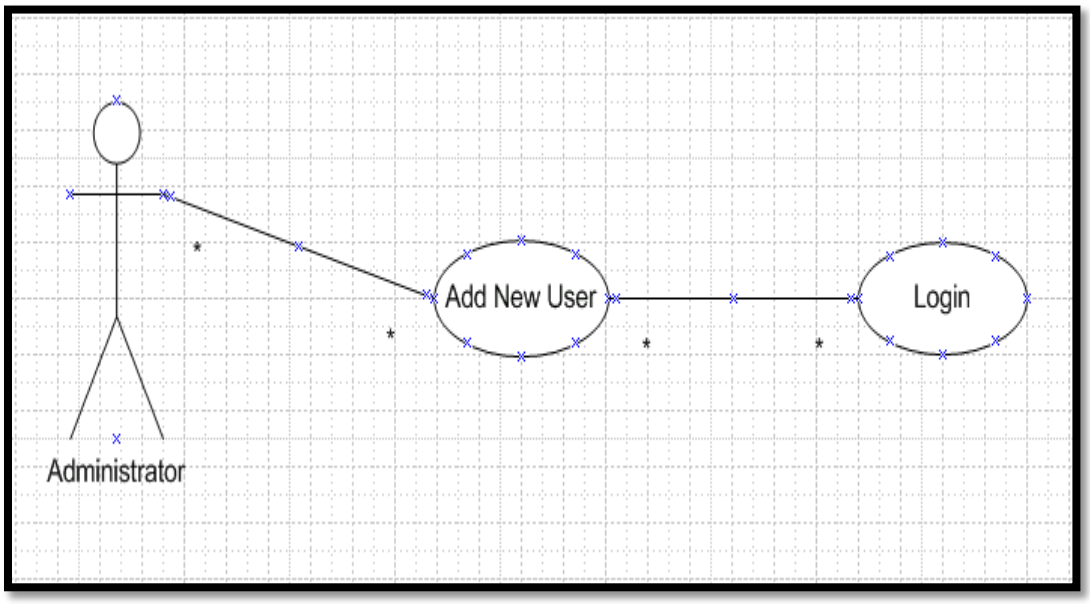

Figure 77 Use Case11

Pre-Conditions

The Web is displayed with grids for searching. The Administrator has a valid username and password.The Administrator is logged into the system.

Basic Course

Use case begins when Administrator accesses the online website.Admin uses his name and password to login.Admin clicks on Add new user and selects between “Add New User” and “Add New Admin” and a page appears containing different fields.Admin clicks on the “Add to Database” button.

Alternate Course

If the administrator enters incorrect username or password, a message appears that incorrect username or password is entered and clicks “Forgot Password” if the administrator has forgotten his password. Admin goes to Step 2 again.If the admin enters incorrect information in the fields, then that field is marked red and admin goes to Step 3 again.

Post Conditions

A new user or new admin is added into the database.

Actors

Administrator

Name: Add New User / Admin via Desktop App

Goal

The Administrator wants to read a tag and add new user to the database.

Diagram

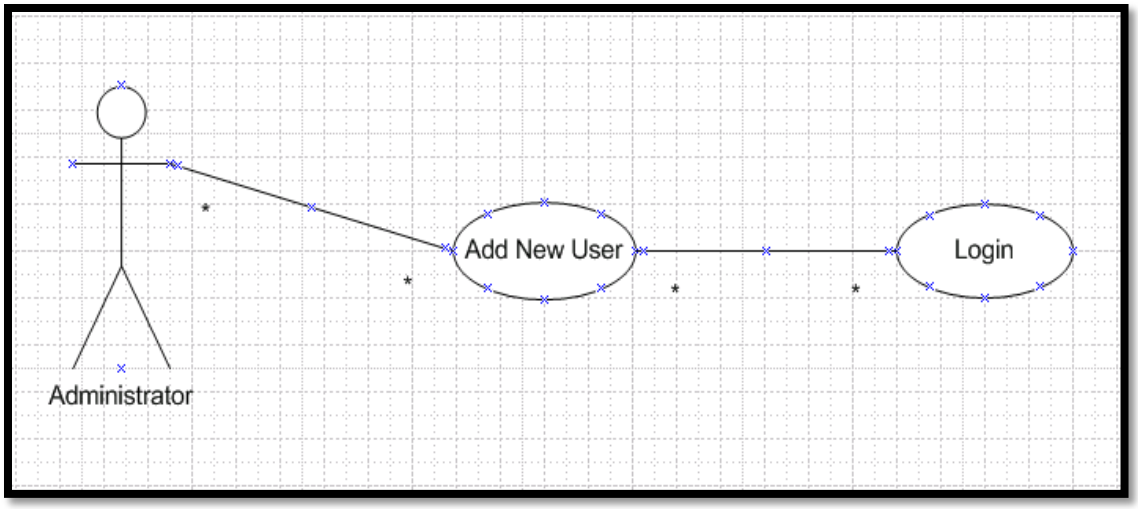

Figure 4.28 Use Case12

Pre-Conditions

The System is turned ON.The antenna is properly integrated with the system.The administrator has logged into the desktop application

Basic Course

Use case begins when the admin places the student/faculty ID card on the proximity antenna.The tag is read and a message prompts that do you want to add a new user or not.Admin clicks “yes”.

Post-Conditions

A new Student/Faculty is added into the database.

Actors

Administrator

Name: Manage Users via Web Portal

Goal

The administrator wants to manage different users.

Diagram

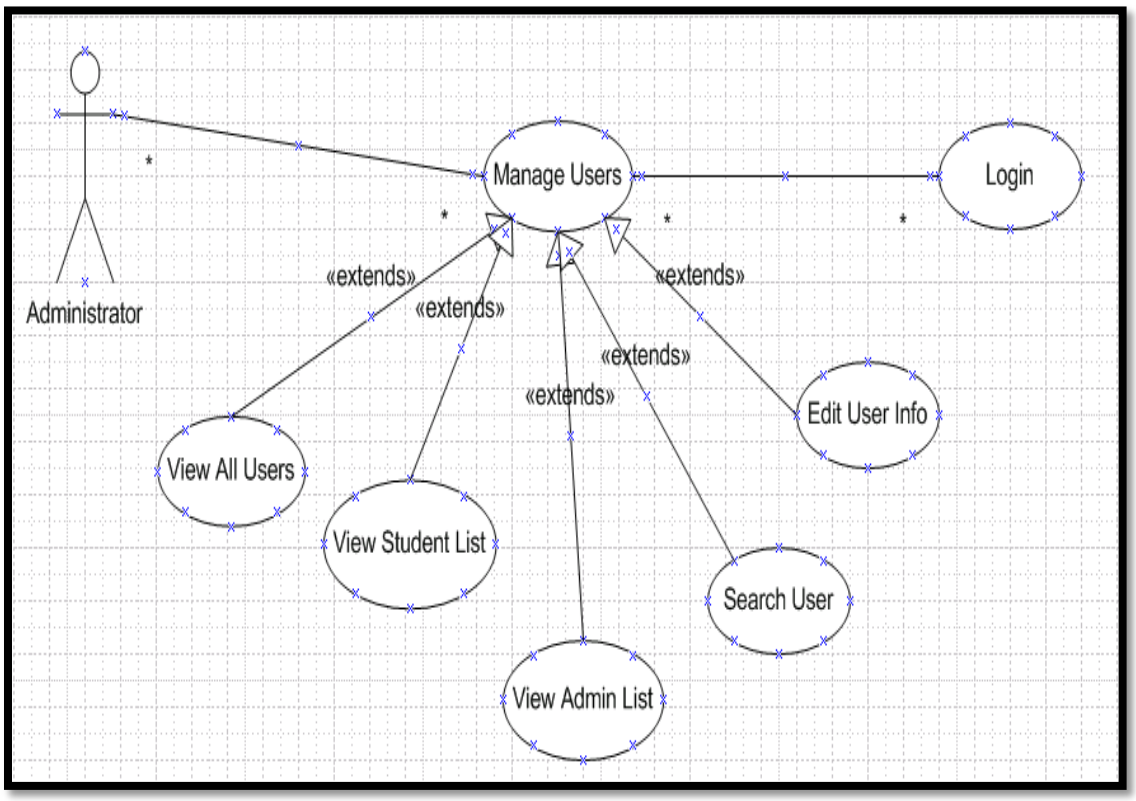

Figure 4.29 Use Case13

Pre-Conditions

The System is turned ON.The antenna is properly integrated with the system.The administrator has logged into the desktop application.

Basic Course

Use case begins when the admin logs into the system and clicks on “Manage Users Button”.A list appears and the admin can select anyone of the above options.

Post-Conditions

The system displays the lists containing information about the tab selected by the administrator.

Actors

Administrator

4.2.1.3.1.3 System Class Diagram

Class diagram shows different classes in the software design. The class diagram is shown in the Figure 4.30 as below:

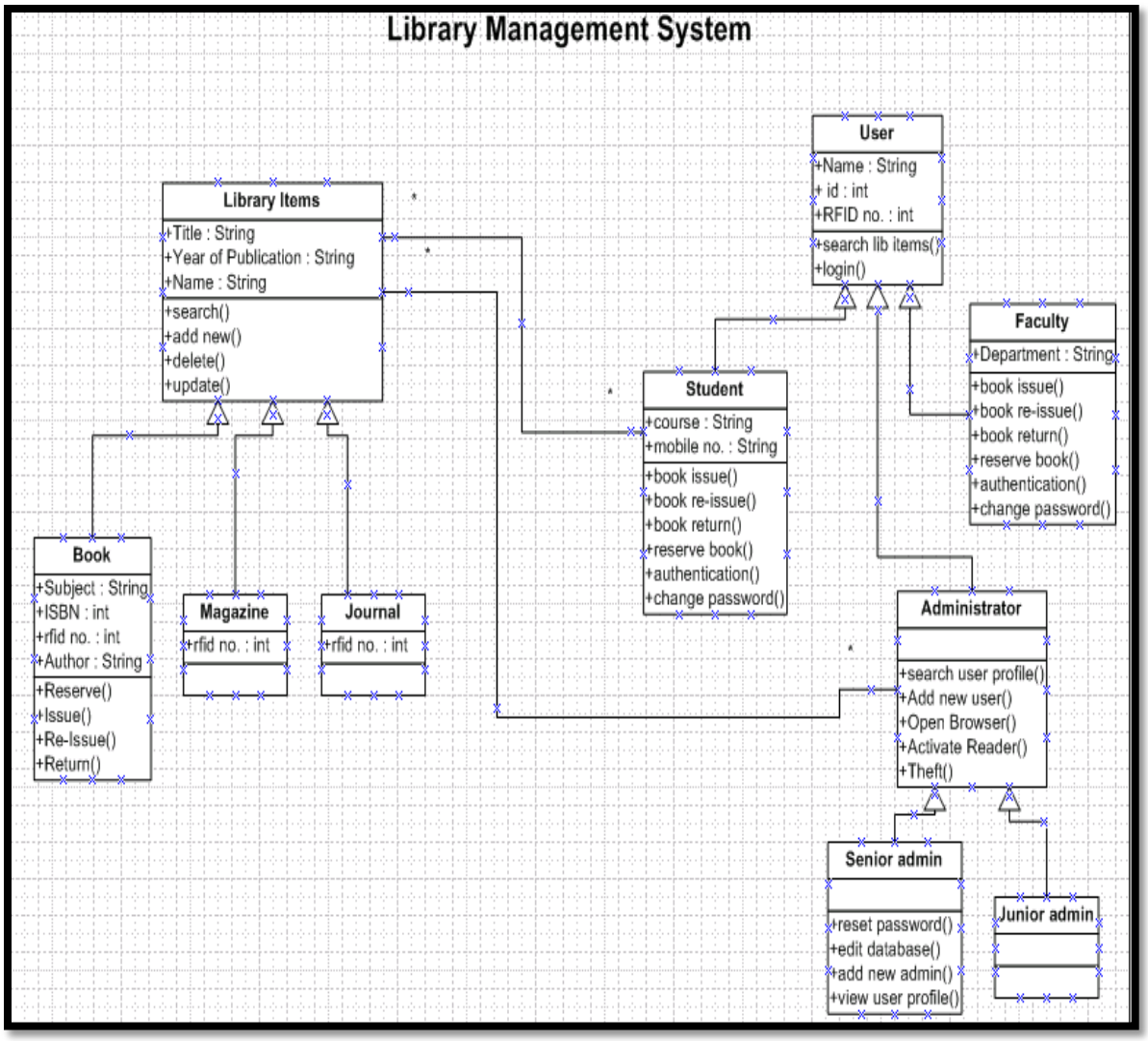

Figure 4.30 System Class Diagram

3.1.4 Entity Relationship Diagram (ERD)

The entity relationship diagram shows the relationship between different entities of the software. Every class has its specific attributes. The ERD for the library system is shown in the Figure 4.31

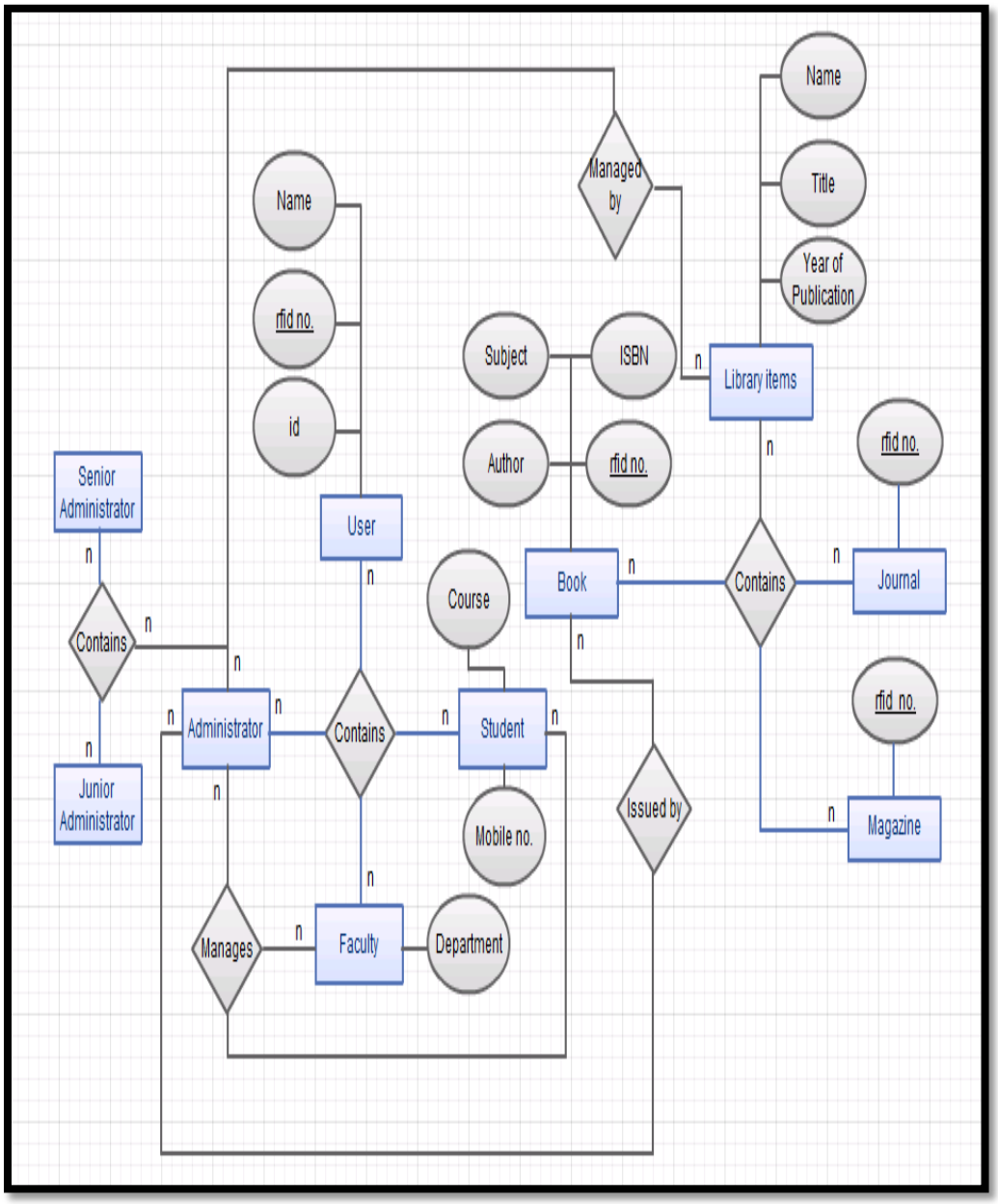

Figure 4.31 Entity Relationship Diagram

4.2.1.3.2 Non-Functional Requirements

Non functional Requirements include specifications of the system on which the software is run.

4.2.13.2.1 System Specification

Processor: 1.3MHz, RAM: 256 MB, Hard-Disk: 200MB, Windows XP, 7, Vista.

4.2.1.3.2.2 Accessibility

The system software will be installed on the administrator's PC and PC will contain an online MySql database.

4.2.1.3.2.3 Speed of the Reader

The minimum reading speed of the reader should be 5 RFID tags.

4.2.1.3.2.4 Security

The server hosting the online database and Web Portal will have their own security to prevent unauthorized access.

The PC on which the Desktop Application resides will have its own security. Only the Administrator will have physical access to the program on it and the application will be locked until it is logged in.

Only the Administrator can view and open the database and no one else can edit the database.

4.2.2 Design Specification Document (SDD) for Library Management System

The SDD Document follows a proper format as defined by ieee. This document specifies the activity diagrams and sequence diagrams for various interactions with the software.

4.2.2.1 Introduction

This section includes a brief overview of the purpose of the software and a brief introduction of various terminologies that are used in the SDD document.

4.2.2.1.1 Purpose

The purpose of this document is to provide a detail description of the design and functions of a library management system using RFID technology. It will explain how the system will interact with users and external environment. It will highlight the factors which will affect the system performance. This document is for project manager, project team and development team. This document will verify that the

current document meets all of the explicit requirements contained in the system model as well as the explicit requirements desired by the customer.

4.2.2.1.2 Glossary

RFID is Radio Frequency Identification; DB is Database for Users and Books; User includes both students and faculty of college or university; Tag Code is a unique code of a tag to identify it; Activity Diagram is used to specify the basic steps in any procedure.

4.2.2.1.3 Reference

www.wikipedia.org, www.google.com

4.2.2.1.4 Overview of Document

The overall system design objective is to provide an efficient design that will reduce system complexity and will make the implementation easy. This document will provide interface design models that are consistent, user friendly and will provide straightforward transitions through various system functions.

4.2.2.2 Data Dictionary

This section includes the description about the different objects of the software engineering cycle.

4.2.2.2.1 Objects

4.2.2.2.1.1 Student / Faculty Object

Student/Faculty is a separate class that ahs specific attributes and methods. Hence it is an object in the software design.

Description

This object contains information such as student's full name, email ID, user ID, RFID tag code etc. The tag code serves as a primary key in the database.

Usage

This object is used to associate with books when they are issued, reversed or returned.

4.2.2.2.1.2 Item Object

An item is also an object as it has specific attributes and methods.

Description

This object contains item type, item name, ISBN etc. The item can be a book, a journal or a magazine.

Usage

The system will issue the item to user who will return the item on desired date.

4.2.2.2.1.3 Junior Administrator Object

The junior administrator is also an object as it has specific attributes and methods.

Description

This object contains information such as user id, email id etc. User id is the primary key.

Usage

This object adds new books, magazines and journal, can view records of issued and reserved books and can also issue books.

4.2.2.2.1.4 Senior Administrator Object

Description

This object contains information such as administrator's full name, username and password

Usage

This object will reset password, edit database, add new admin and view user profile.

4.2.2.2.2 Class Diagram

The class diagram in the Figure 4.32 shows the system's classes, their attributes and the relationship between classes.

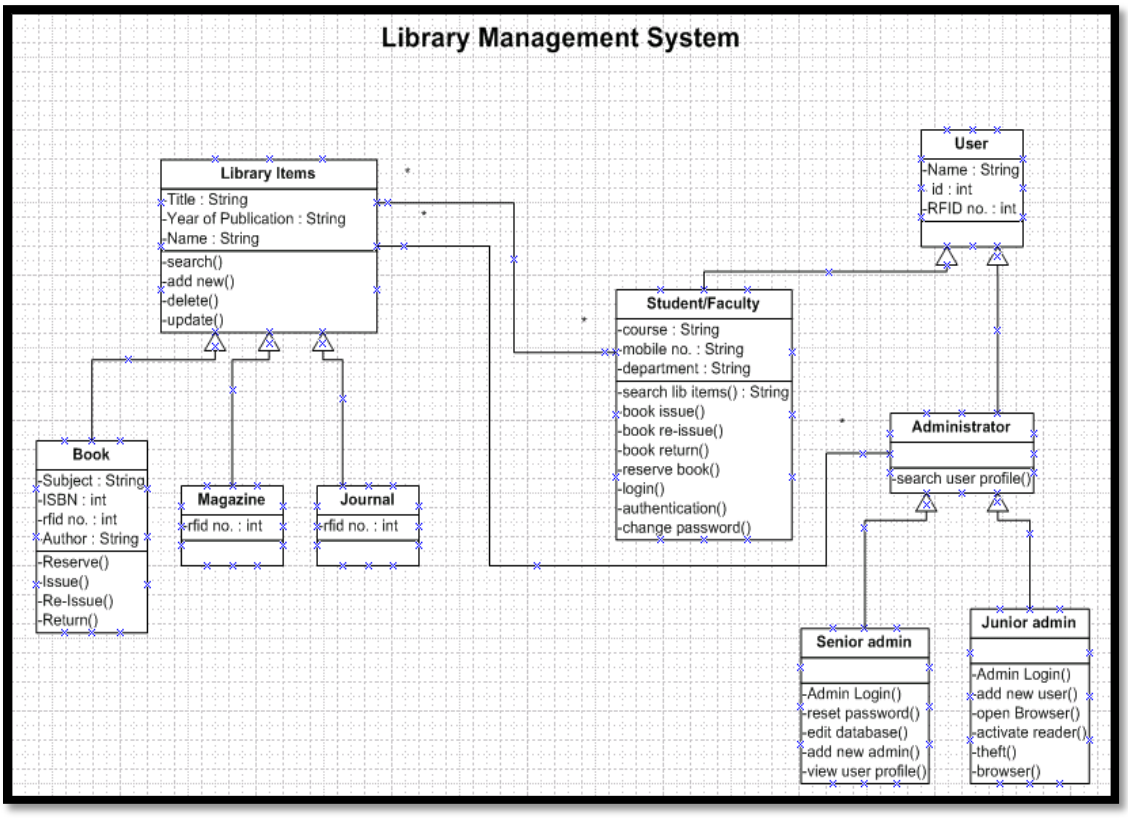

Figure 4.32 Class Diagram for Library Management System

4.2.2.3 Architectural Design

This system will be capable of performing all the functions required in the library. Each function is explained below:

a. Adding a Member

The system will read the user or student card of the member and will check for the member in the database. If the member already exists in the database, a message will prompt indicating that database contains this entry. Otherwise the database will be updated.

b. Adding an Item

Item can be a book, magazine or journals. Whenever a new item arrives, the system will the tag of the item, will check the code in the database. If the database already contains the item, an error message will appear otherwise the item will be added in the database along with its details.

c. Editing the database

The administrator will be able to edit the database, that is whenever there is any change in details of members or the items, the database will be updated.

d. Issue of Item

This operation will involve two steps. First the member (student or faculty) will have to show his/ her user card to proximity antenna. The system will check the validity of the member in the database. After authentication, the member will have to show the item in order to get it issued. After issuing the issued bit will be updated in the database.

e. Return of Item

The system will read the item and will check it in the database. A message will prompt asking whether the member wants to return the item or reissue it. In the case member chooses to return the item, the issue bit will be reset and message will appear showing that the item has been return. If the member chooses to reissue the book, system

will ask for identification of the member. And after authentication, the item will be reissued.

4.2.2.3.1 Activity Diagram

Activity diagram is used to show the specific activities involved in a procedure. Each procedure is completed only after the completion of a series of activities.

Add User

Figure 4.33 shows the activity diagram when a new user is added.

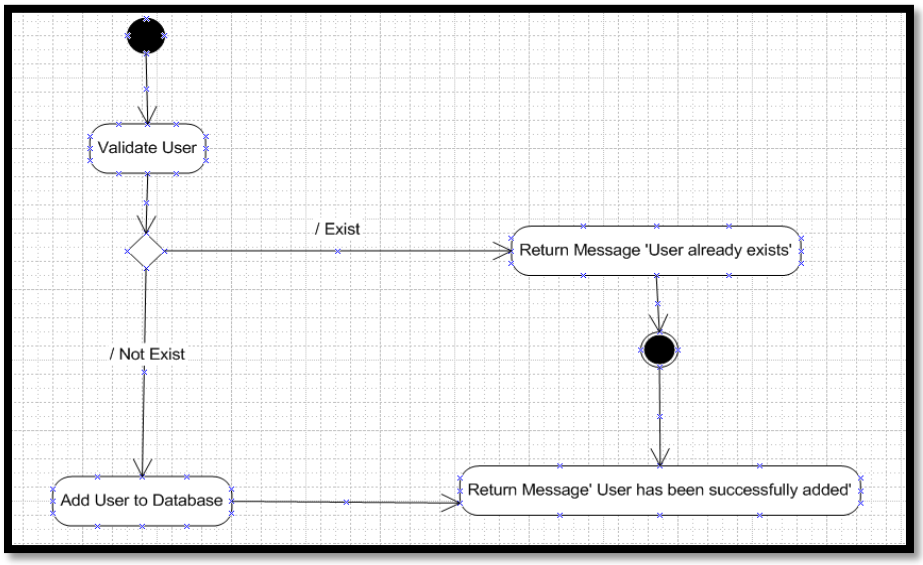

Figure 4.33 Add User Activity Diagram

Delete User

Figure 4.34 shows the activity diagram when an existing user is deleted.

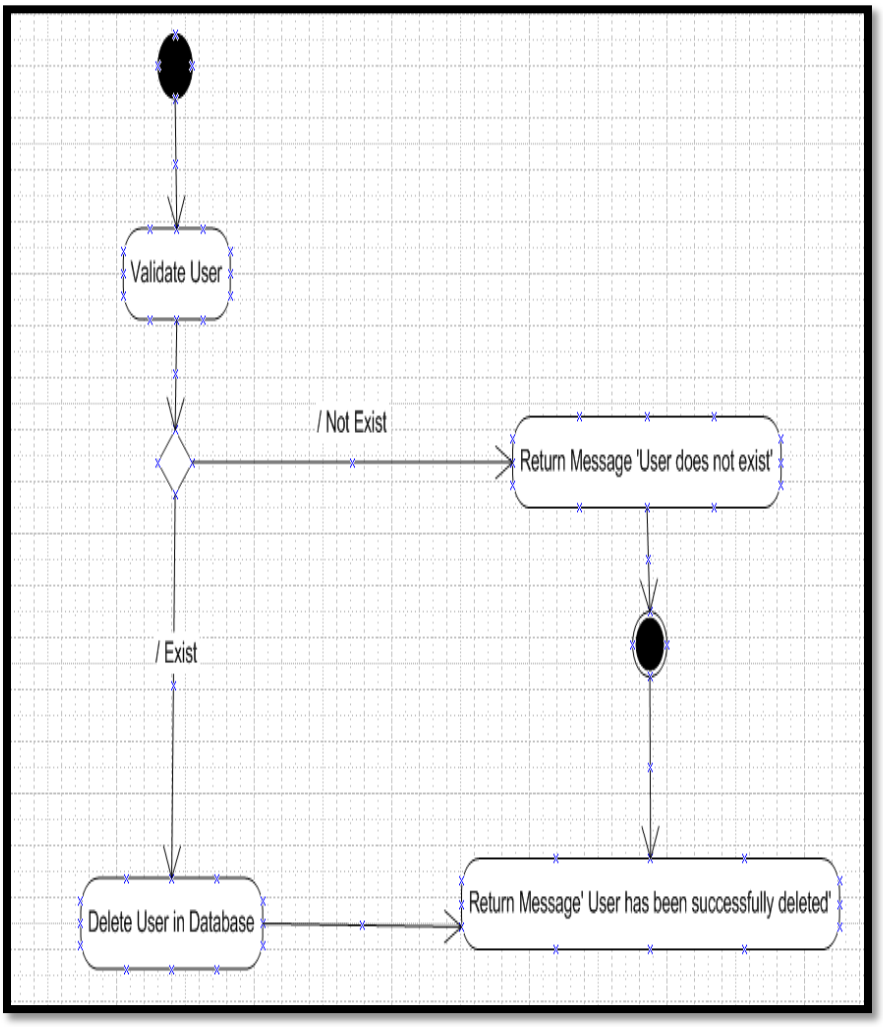

Figure 4.34 Delete User Activity Diagram

Update User Data

Figure 4.35 shows the activity diagram when the data of a user id updated.

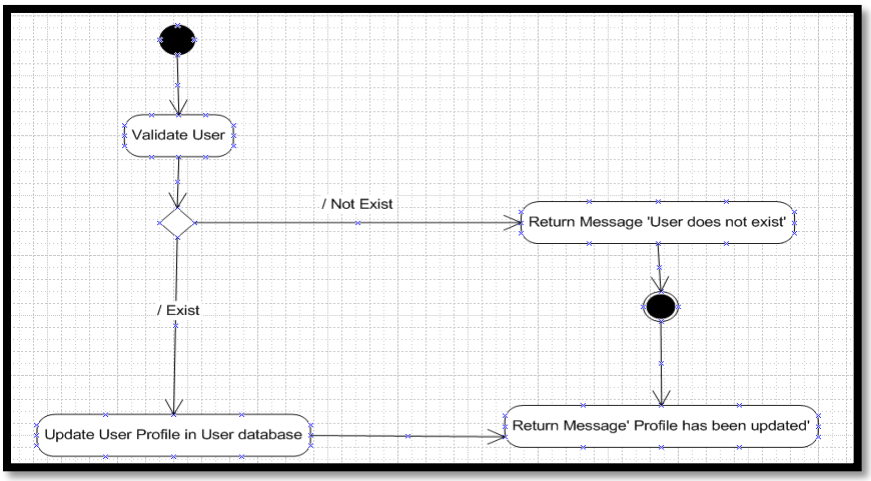

Figure 4.35 Update User Data Activity Diagram

Search User

Figure 4.36 shows the activity diagram when a user is searched.

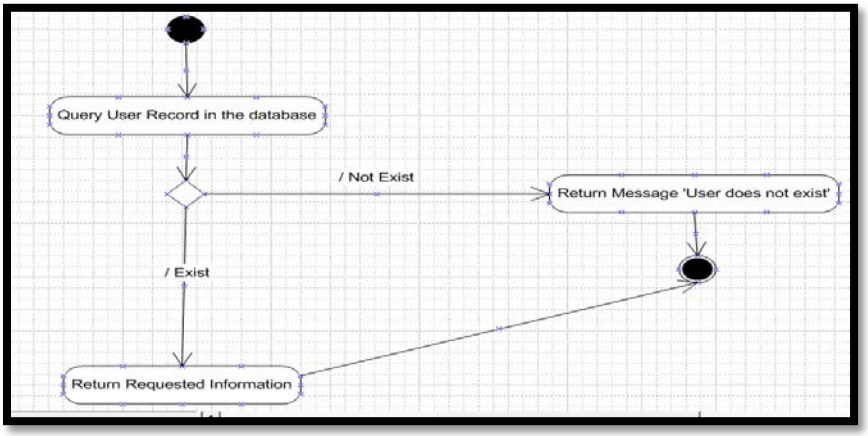

Figure 4.36 Search User Activity Diagram

Validate User

Figure 4.37 shows the activity diagram when a user is validated at the time of login into the system

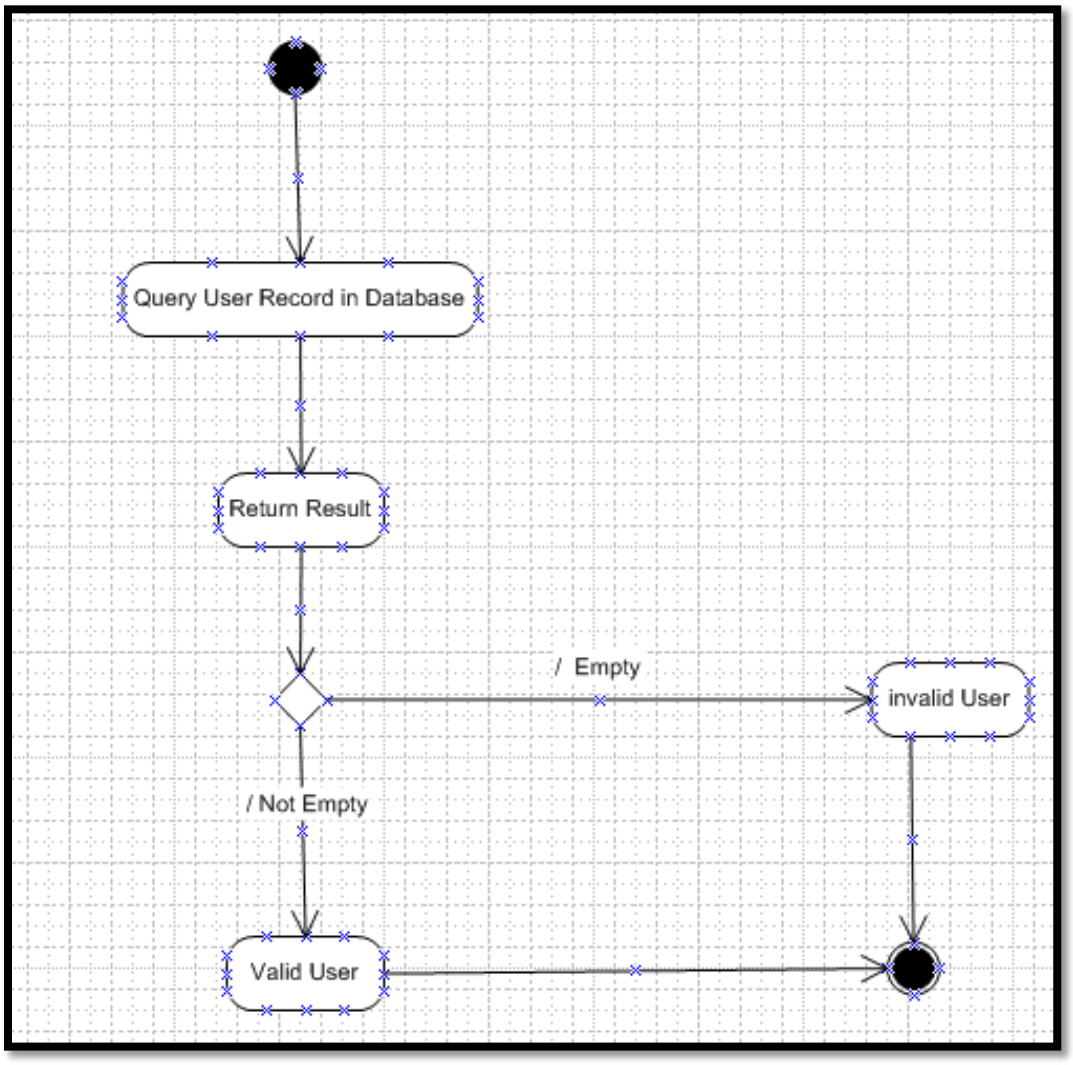

Figure 4.37 Validate User Activity Diagram

Add New Item

Figure 4.38 shows the activity diagram when a new item is added.

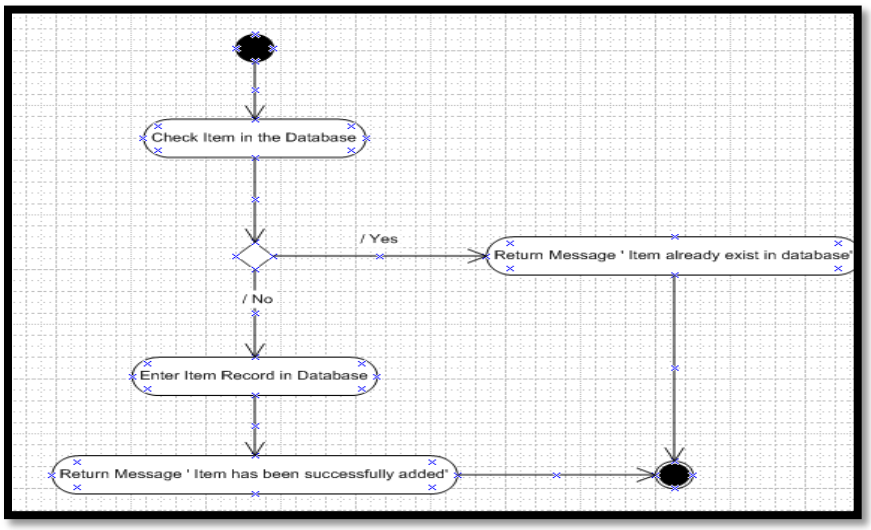

Figure 4.38 Add New Item Activity Diagram

Delete Item

Figure 4.39 shows the activity diagram when an existing item is deleted.

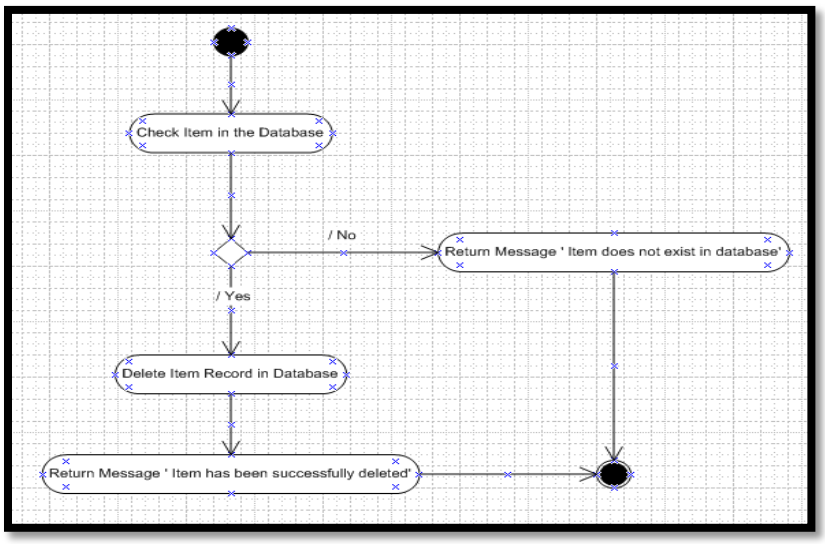

Figure 4.39 Delete Item Activity Diagram

Update Item

Figure 4.40 shows the activity diagram when an item is updated.

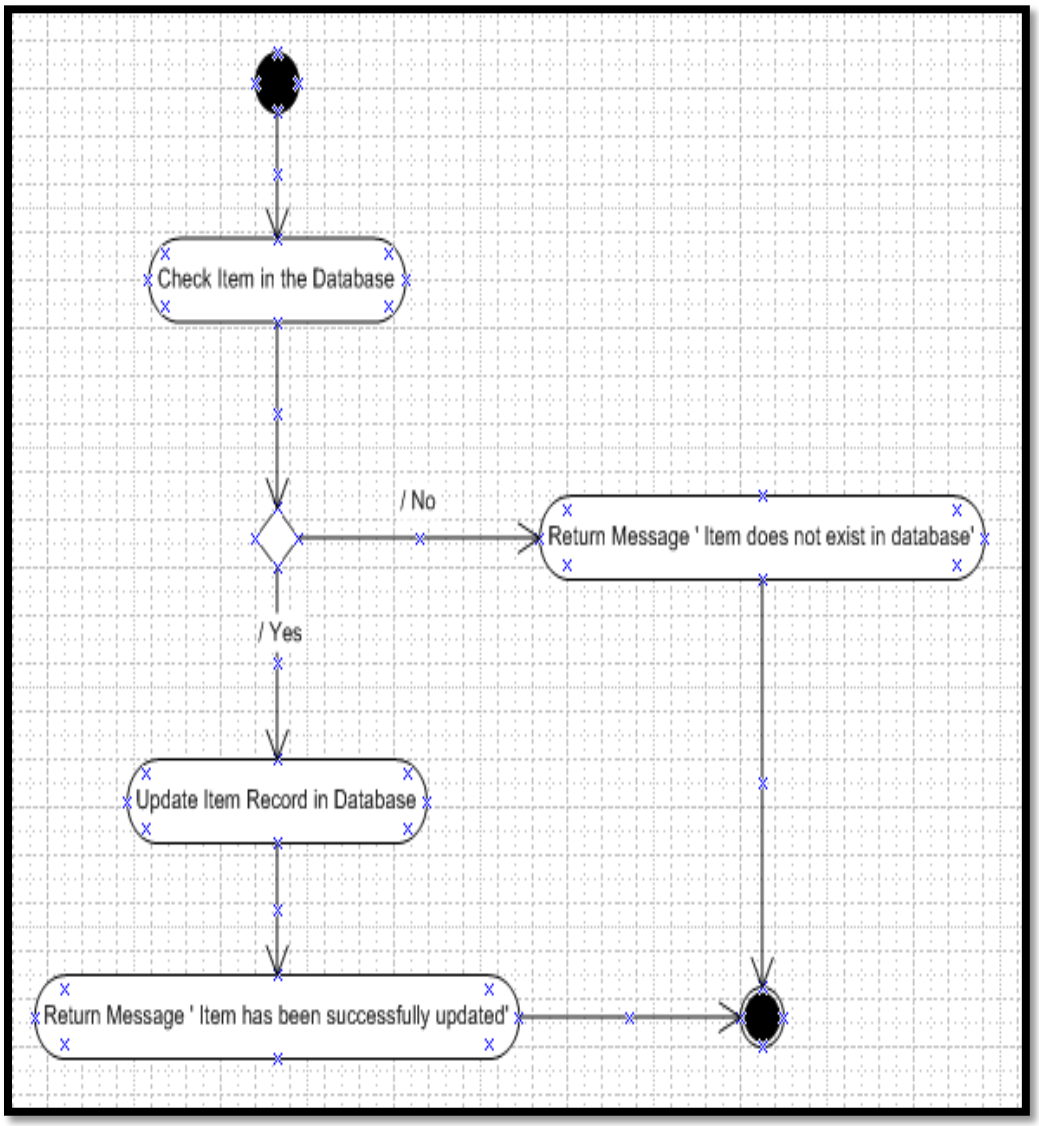

Figure 4.40 Update Item Activity Diagram

Search Item

Figure 4.41 shows the activity diagram when an item is searched.

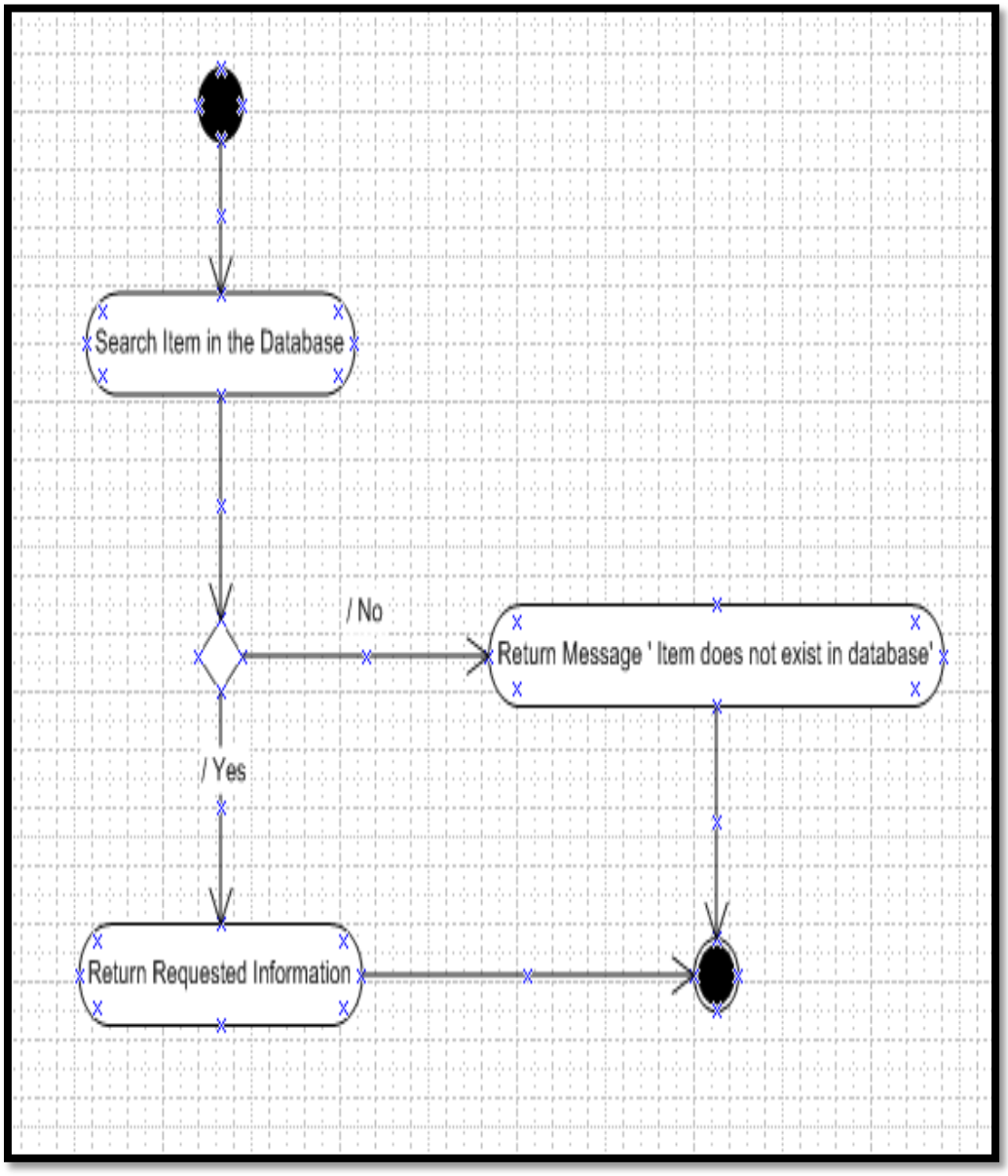

Figure 4.41 Search Item Activity Diagram

Issue Book

Figure 4.42 shows the activity diagram when a book is issued by a user.

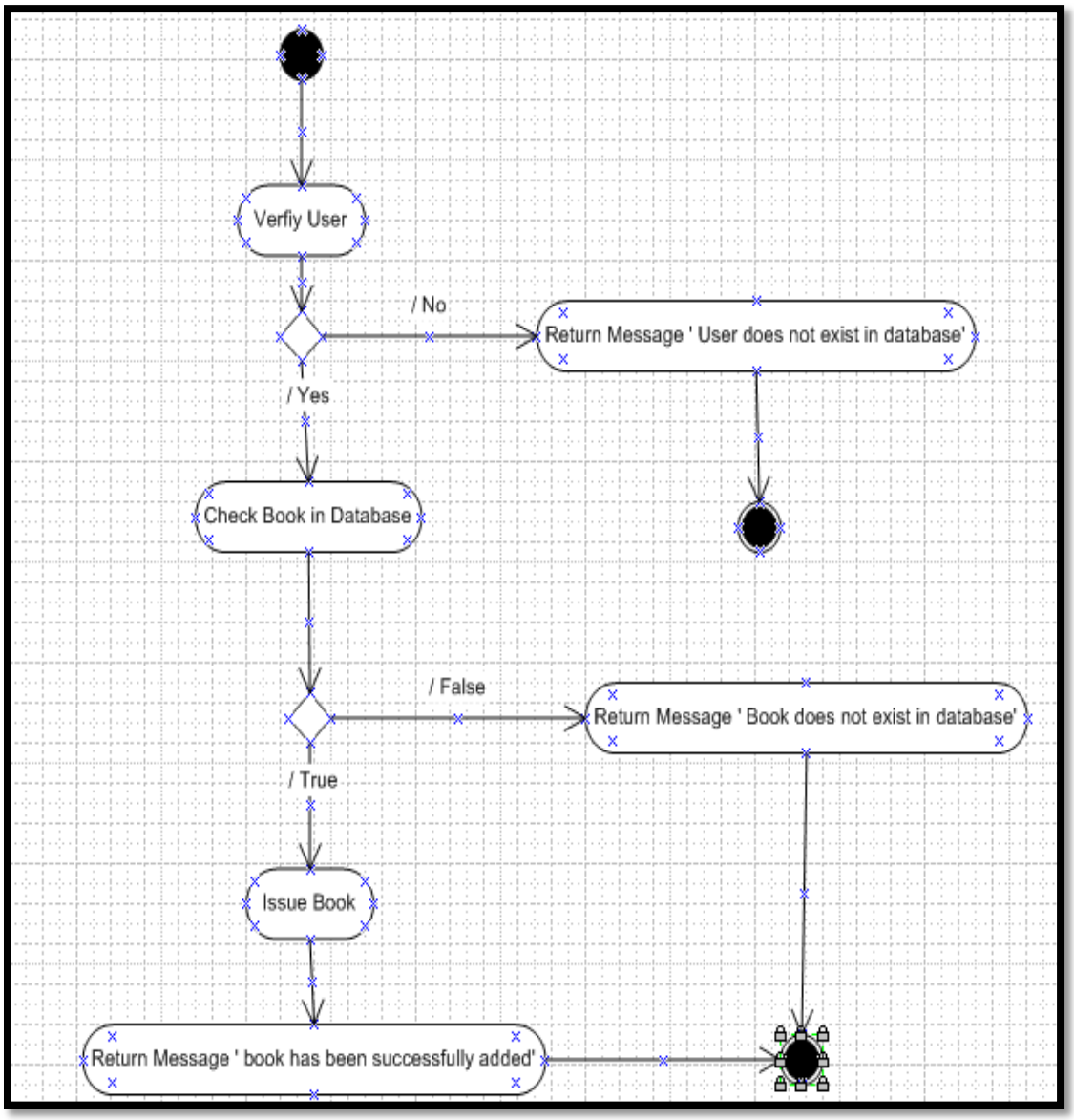

Figure 8.42 Issue Book Activity Diagram

Return Book

Figure 4.43 shows the activity diagram when an issued book is returned.

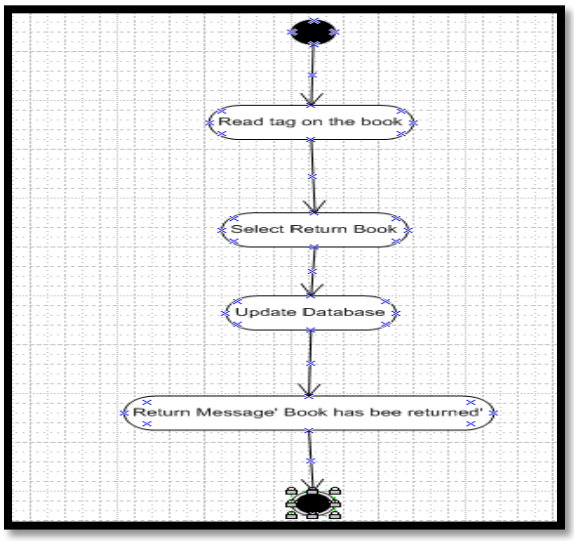

Figure 4.43 Return Book Activity Diagram

Reissue Book

Figure 4.44 shows the activity diagram when an issued book is reissued.

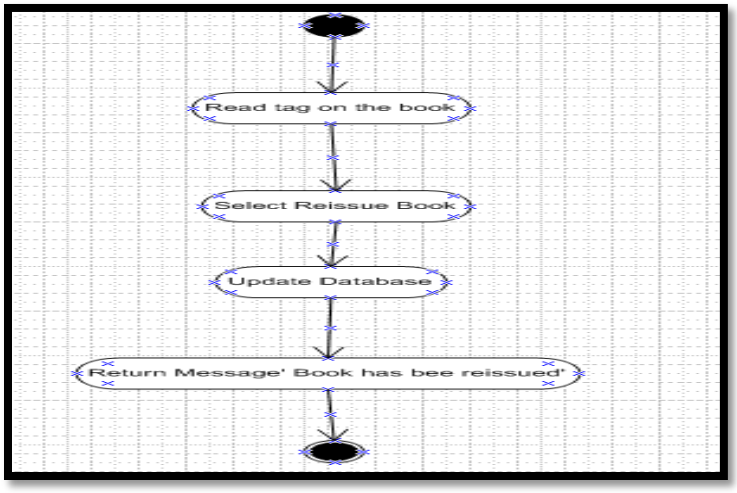

Figure 4.44 Reissue Book Activity Diagram

View Details

Figure 4.45 shows the activity diagram when a user views the details on the online portal.

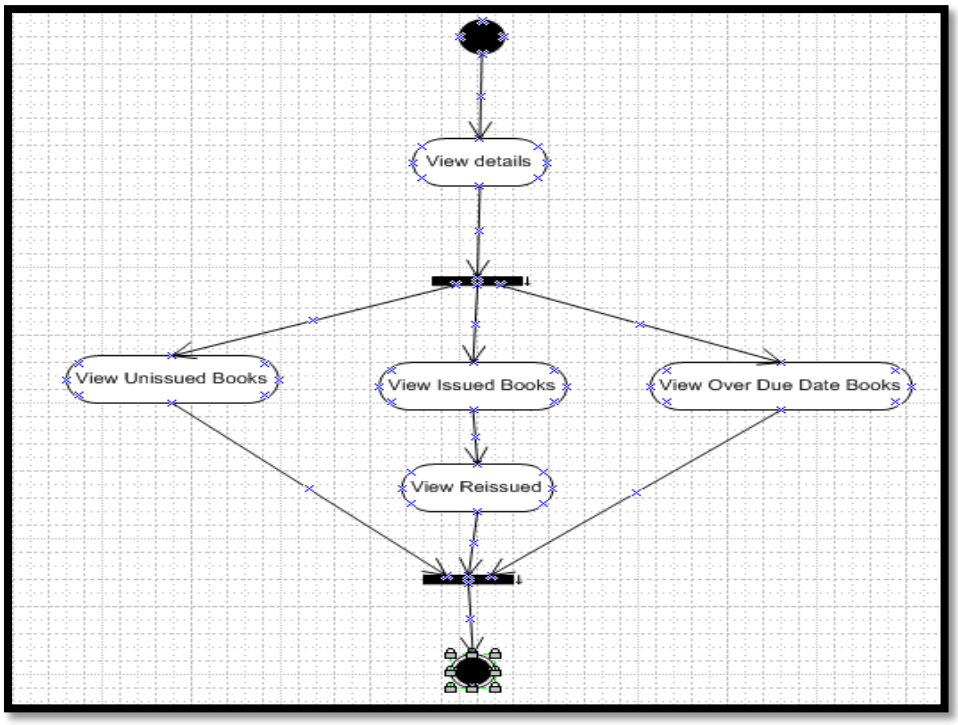

Figure 4.45 View Details Activity Diagram

4.2.2.3.2 Sequence Diagram

Sequence Diagrams are used to show the sequence of activities when a specific procedure is invoked.

4.2.2.3.2.1User Case

This section explains in detail the sequence diagrams for the user i.e. what happens if a user interacts with the software.

User Login: Normal Case

Figure 4.46 shows the normal case for user login into the system.

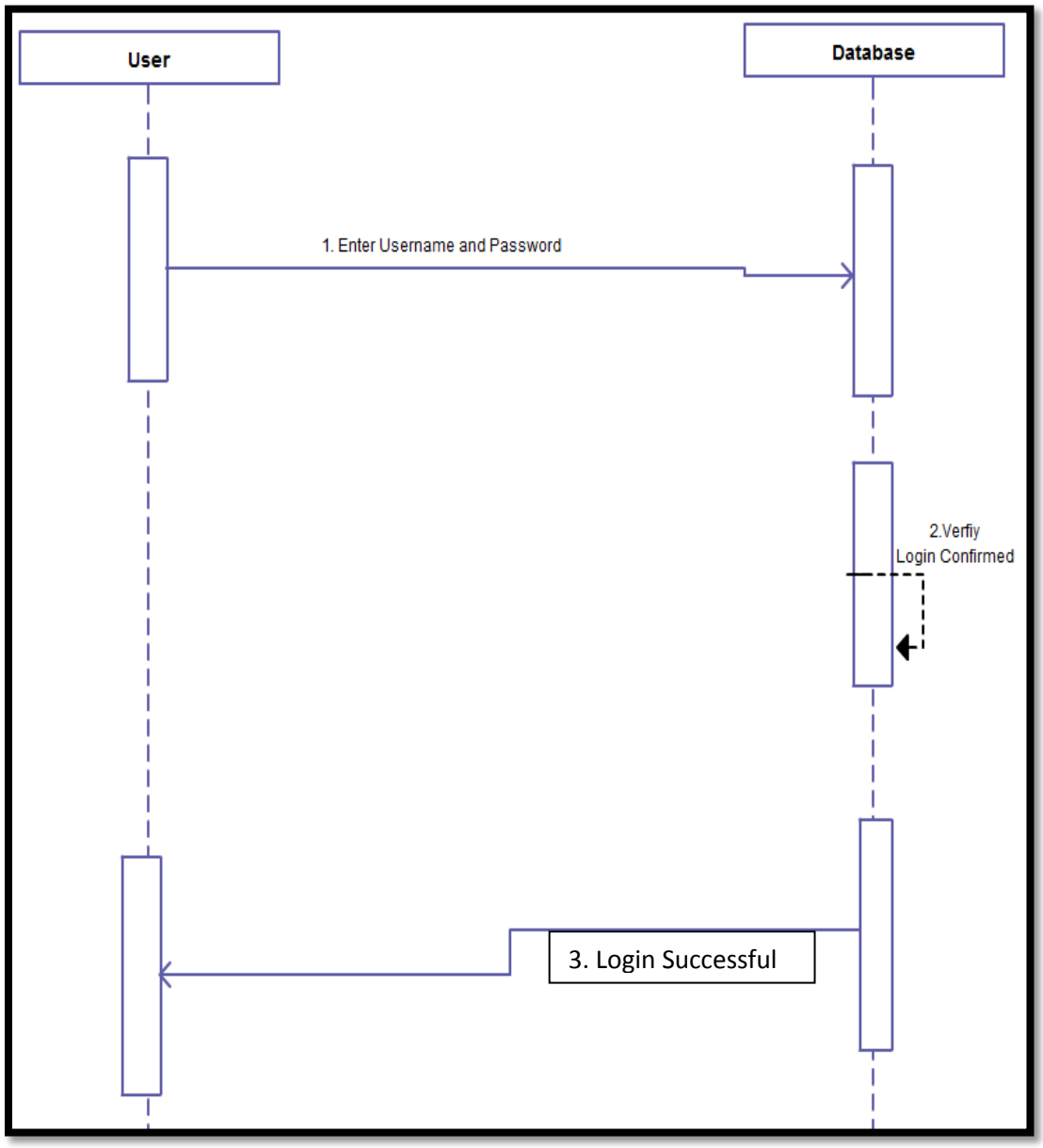

Figure 4.46 Login Normal Case

User Login: Exceptional Case

Figure 4.47 shows the exceptional case for user login into the system. Exceptional case means any case other than the normal way.

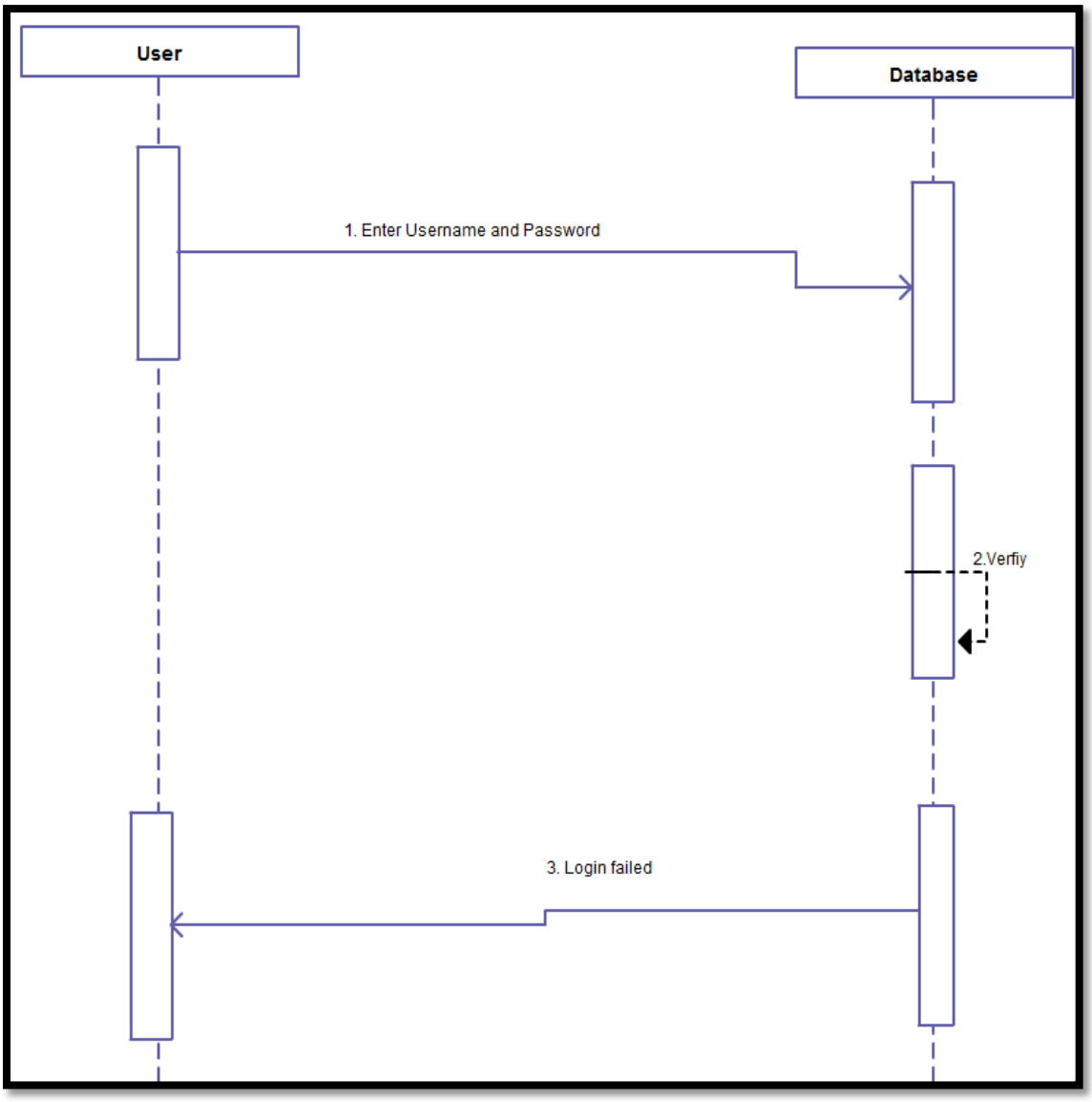

Figure 4.47 Login Exceptional Case

Sign-up/ Registration: Normal Case

Figure 4.48 shows the normal case for signup.

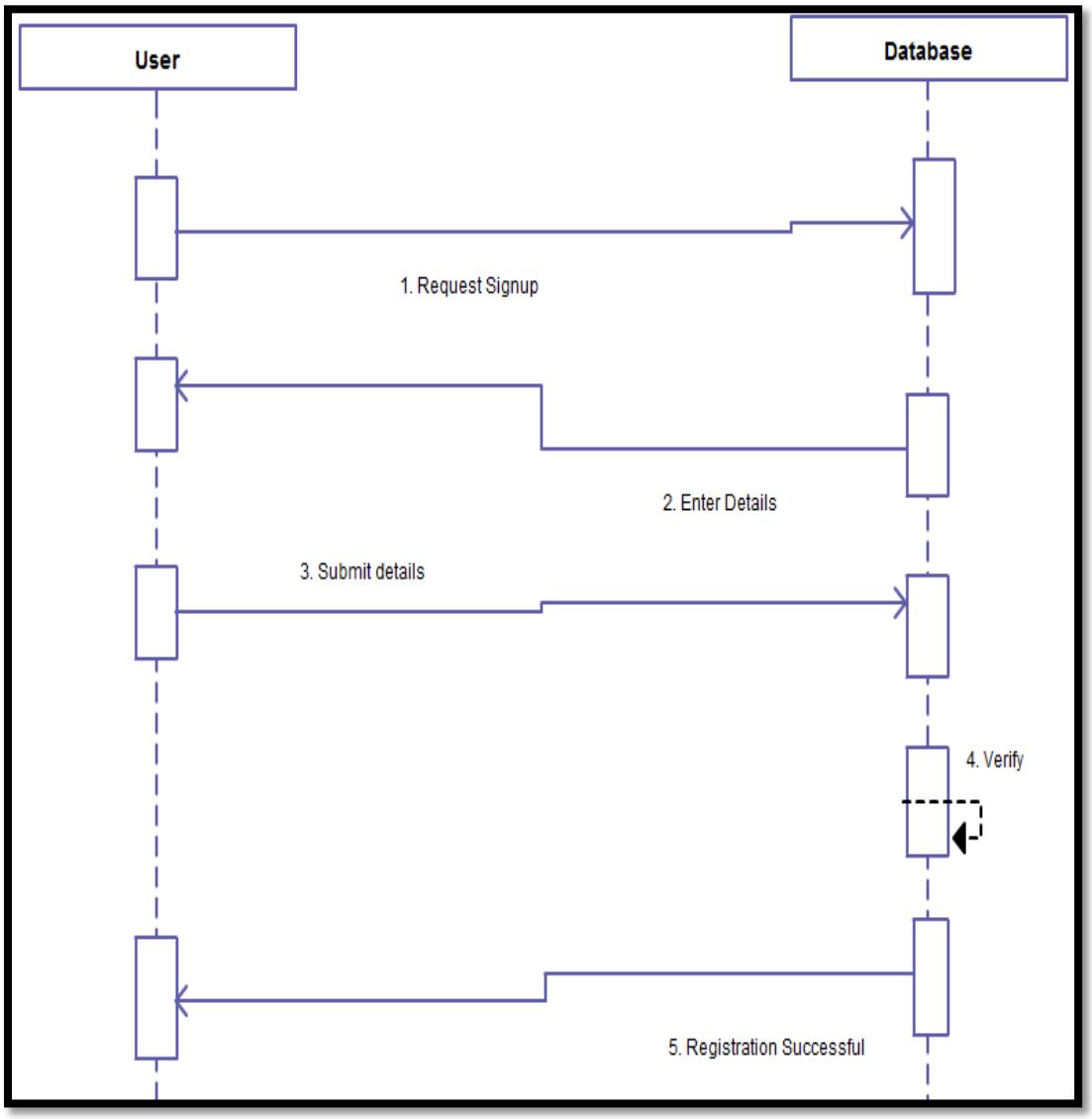

Figure 4.48 Signup Normal Case

Exceptional Case1

Figure 4.49 shows the exceptional case 1 for user login into the system.

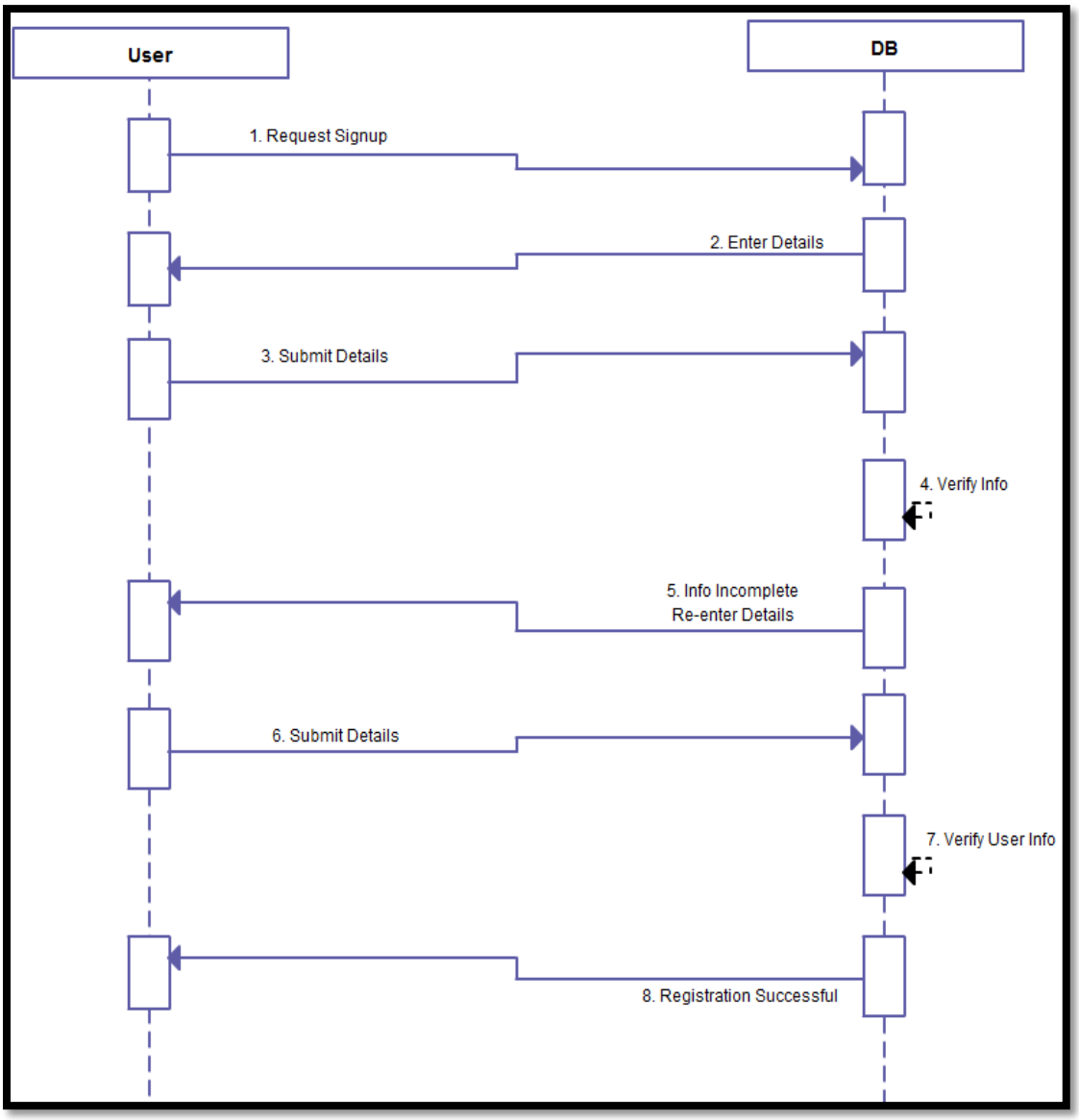

Figure 4.49 Signup Exceptional Case1

Exceptional Case2

Figure 4.50 shows the exceptional case 2 for user login into the system.

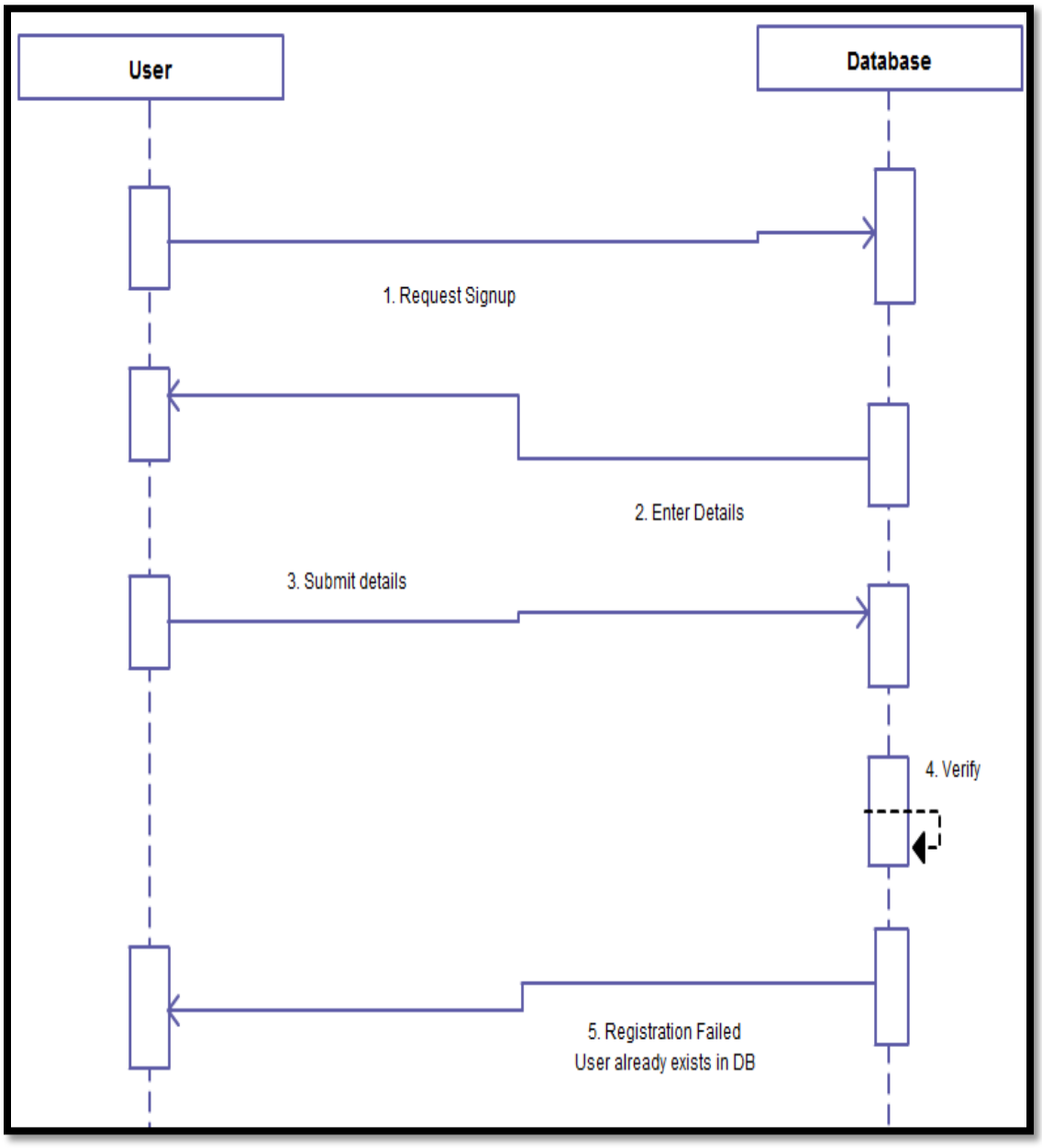

Figure 4.50 Signup Exceptional Case2

Search: Normal Case

Figure 4.51 shows the normal case for search in the online portal.

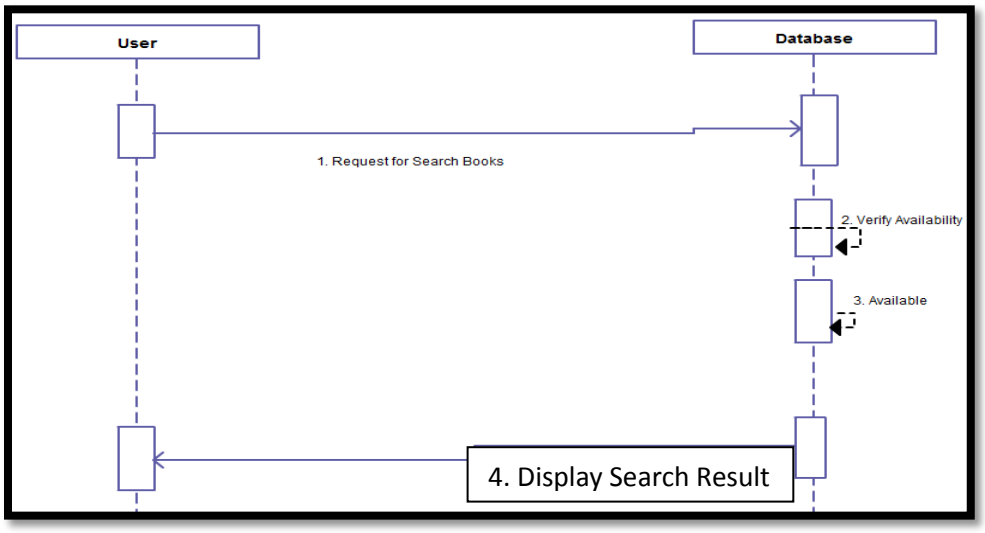

Figure 4.51 Search Normal Case

Exceptional Case

Figure 4.52 shows the exceptional case for search in the online portal.

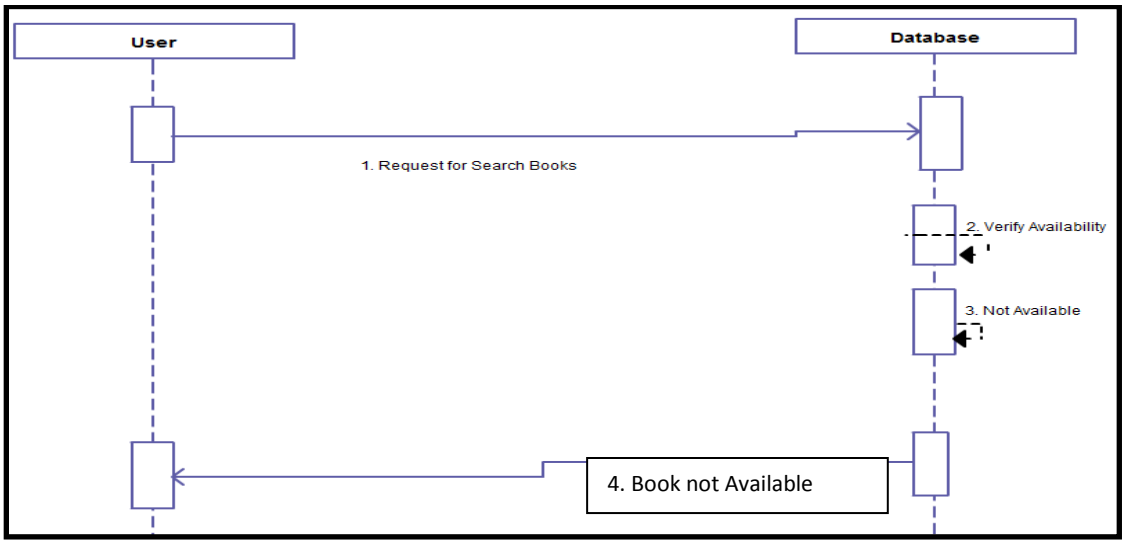

Figure 5.52Search Exceptional Case

Issue Book: Normal Case

Figure 4.53 shows the normal case for issuing a book.

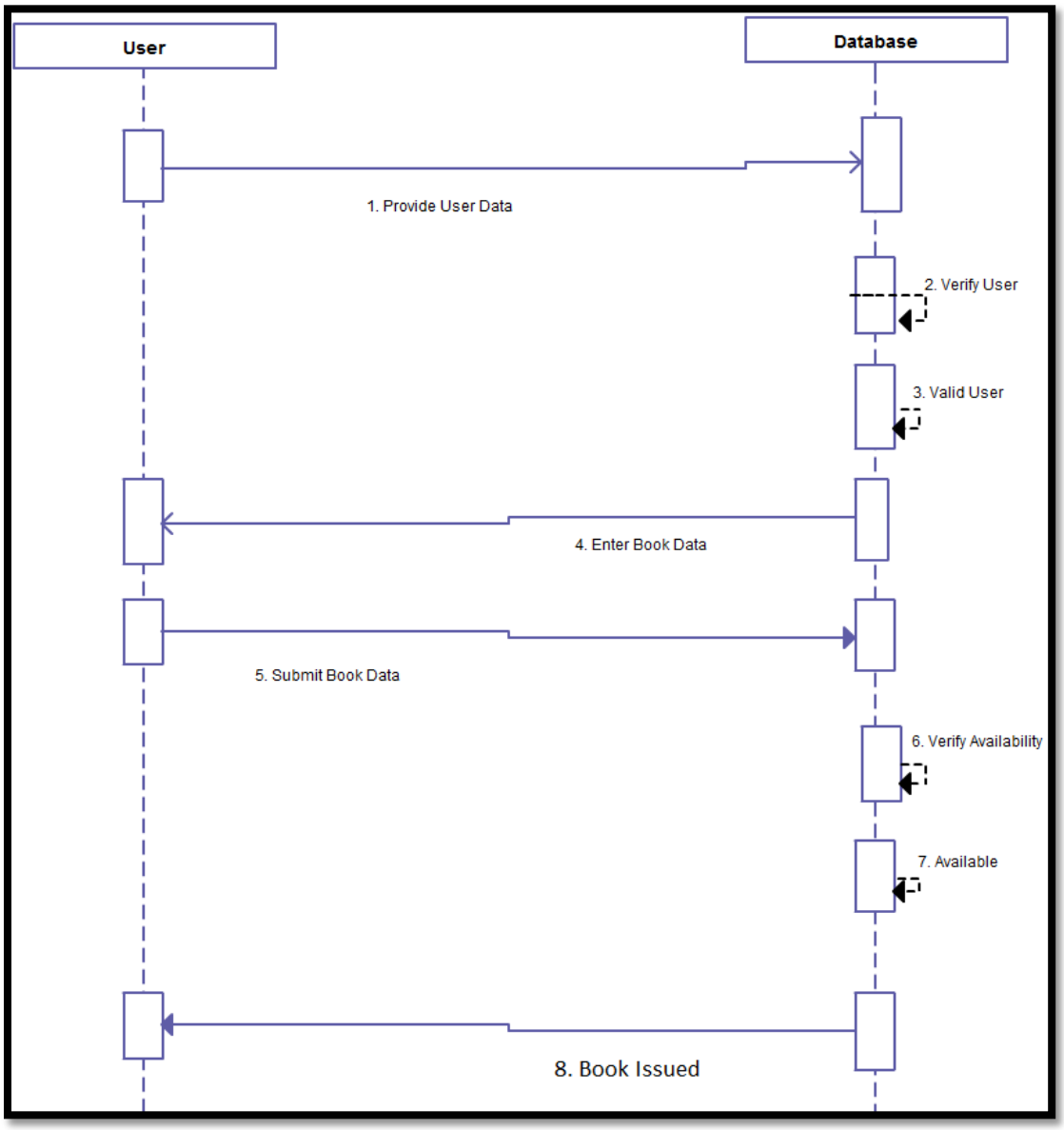

Figure 5.53 Issue Normal Case

Exceptional Case1

Figure 4.54 shows the exceptional case 1 for book issue.

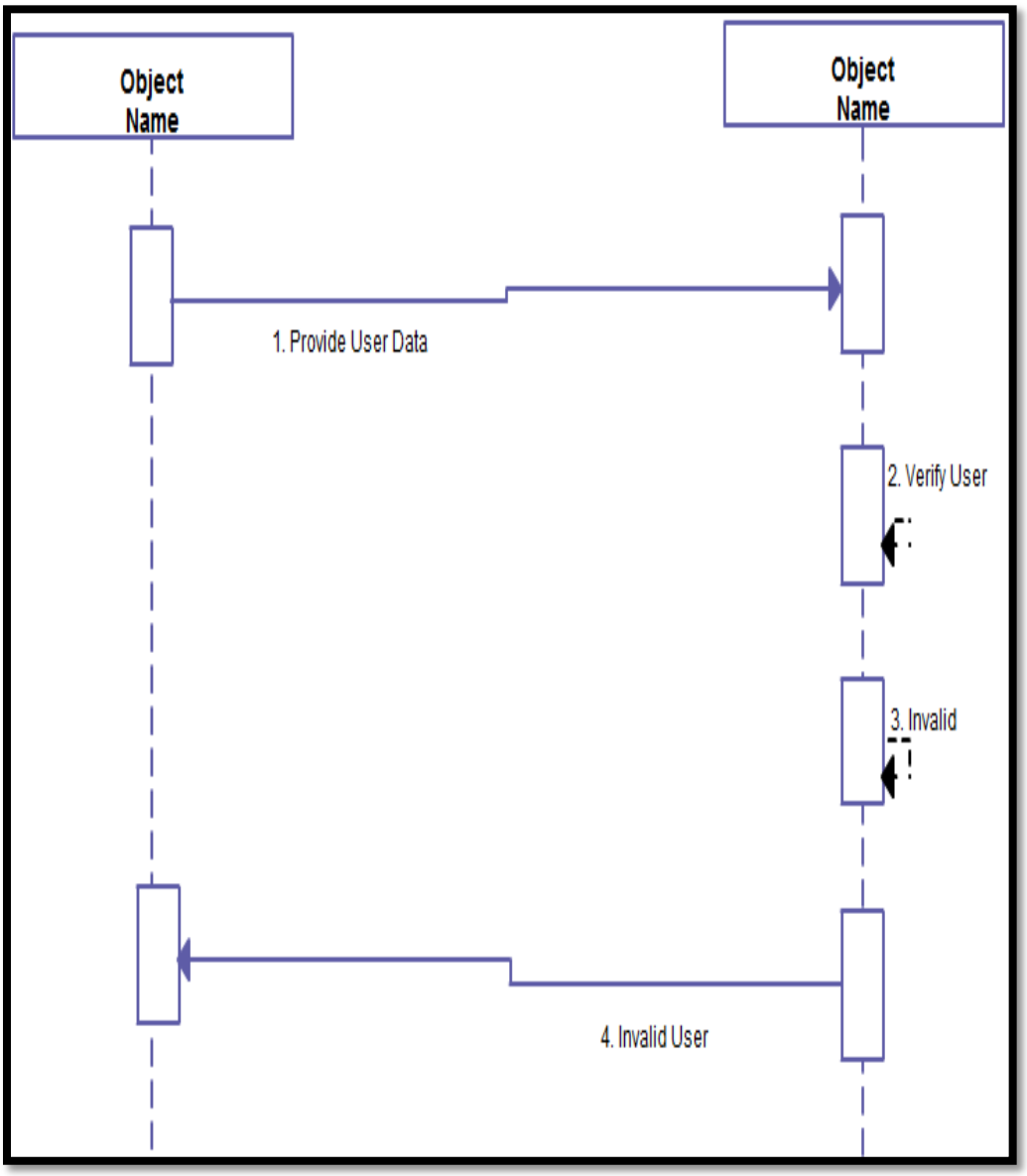

Figure 4.54Issue Exceptional Case1

Exceptional Case2

Figure 4.55 shows the exceptional case 2 for book issue.

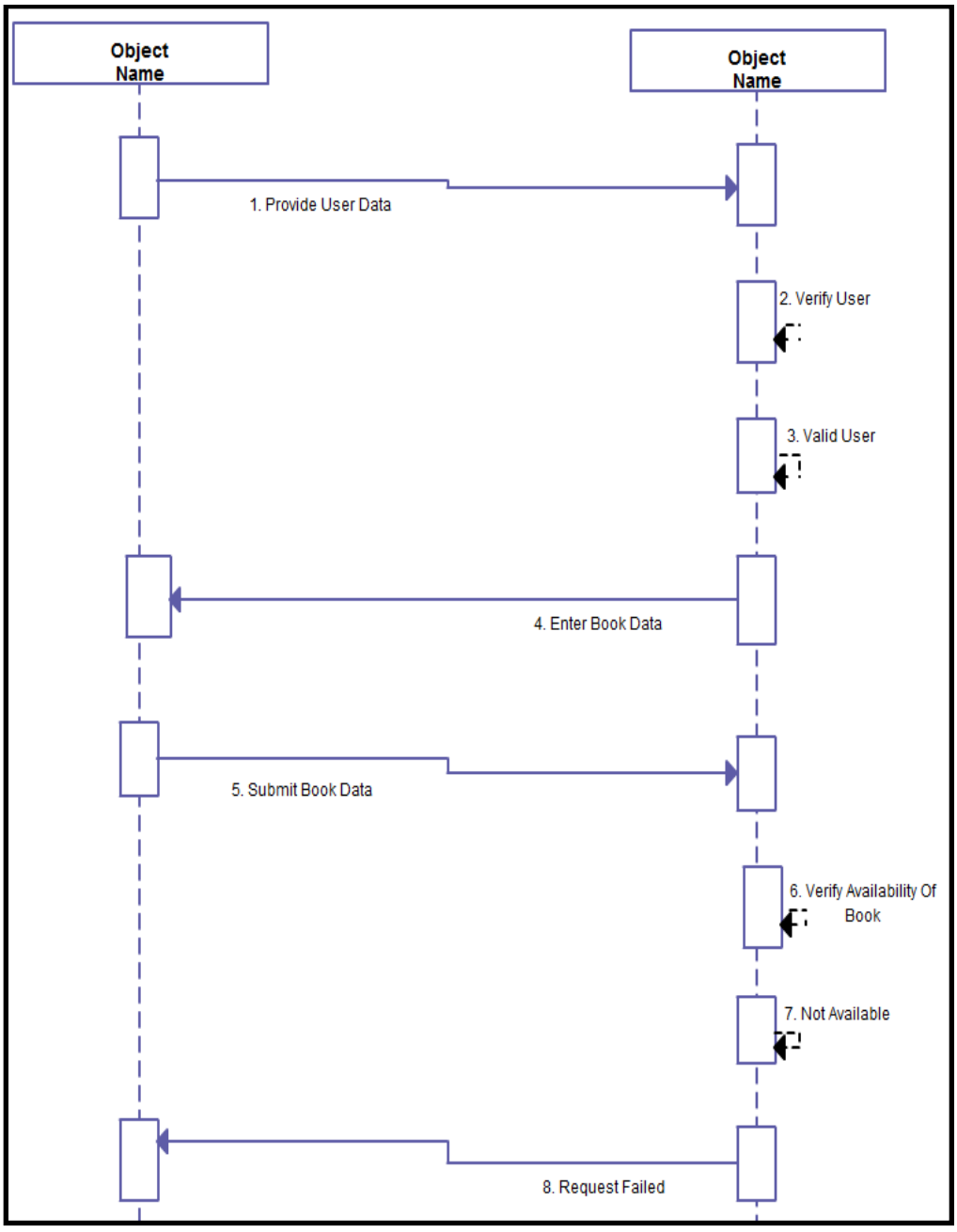

Figure 4.55 Exceptional Case2

Return Book: With Fine

Figure 4.56 shows the case for book return with fine i.e. when a user has kept the book for more than the allowed number of days.

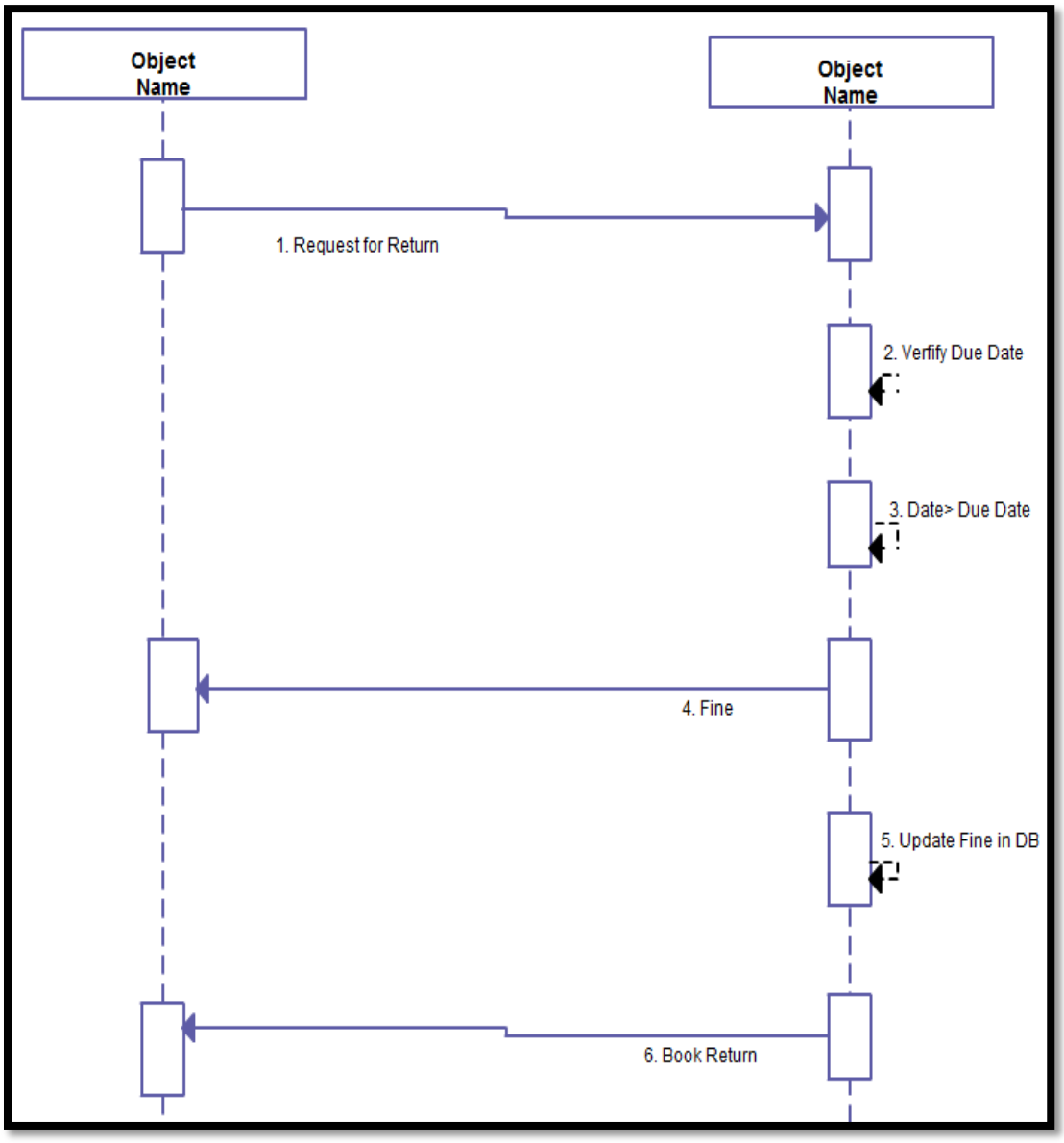

Figure 4.56 Return Book with Fine

Without Fine

Figure 4.57 shows the case for book return without fine.

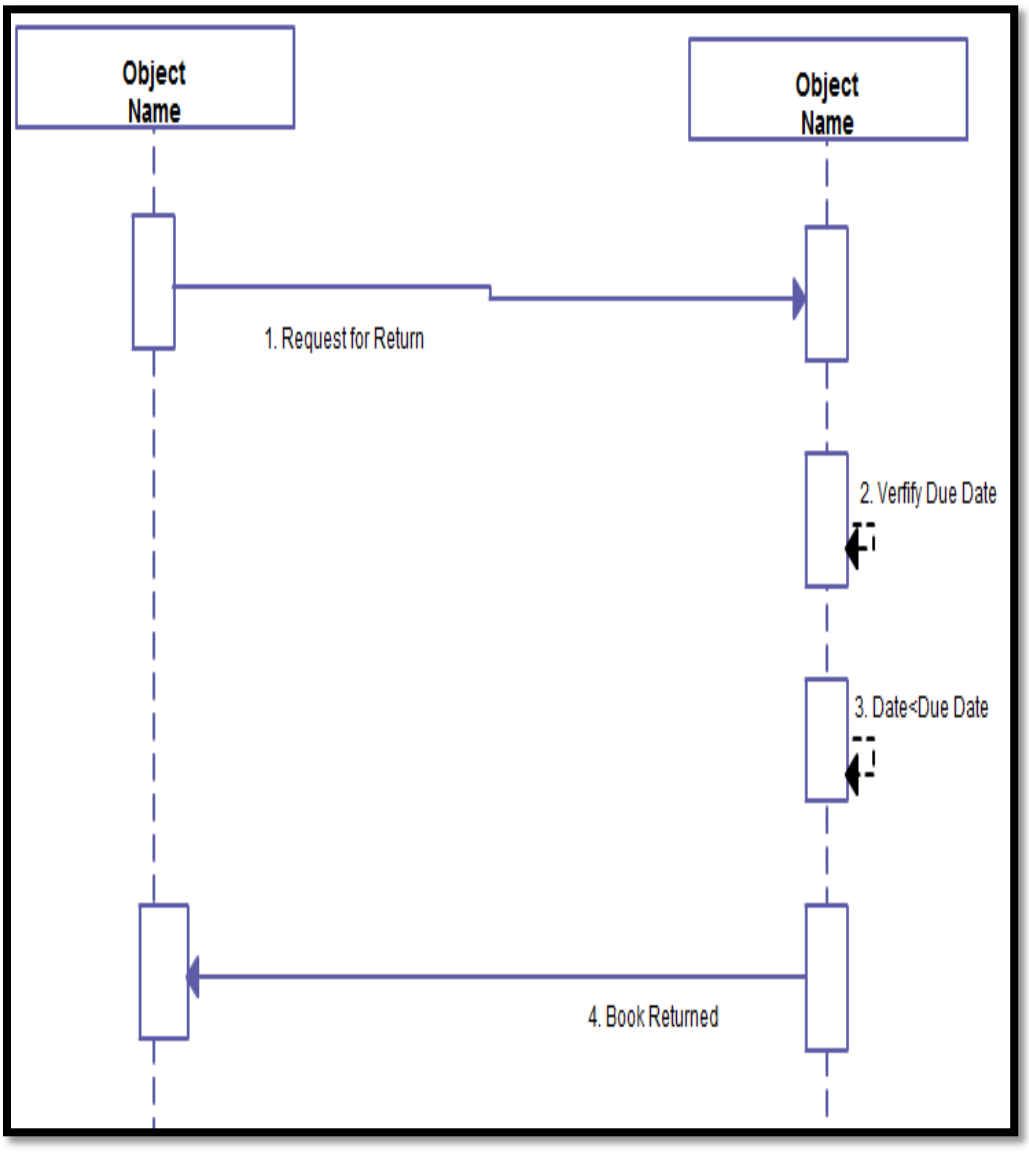

Figure 4.57Return without Fine

Reissue Book: Normal Case

Figure 4.58 shows the normal case for book reissue.

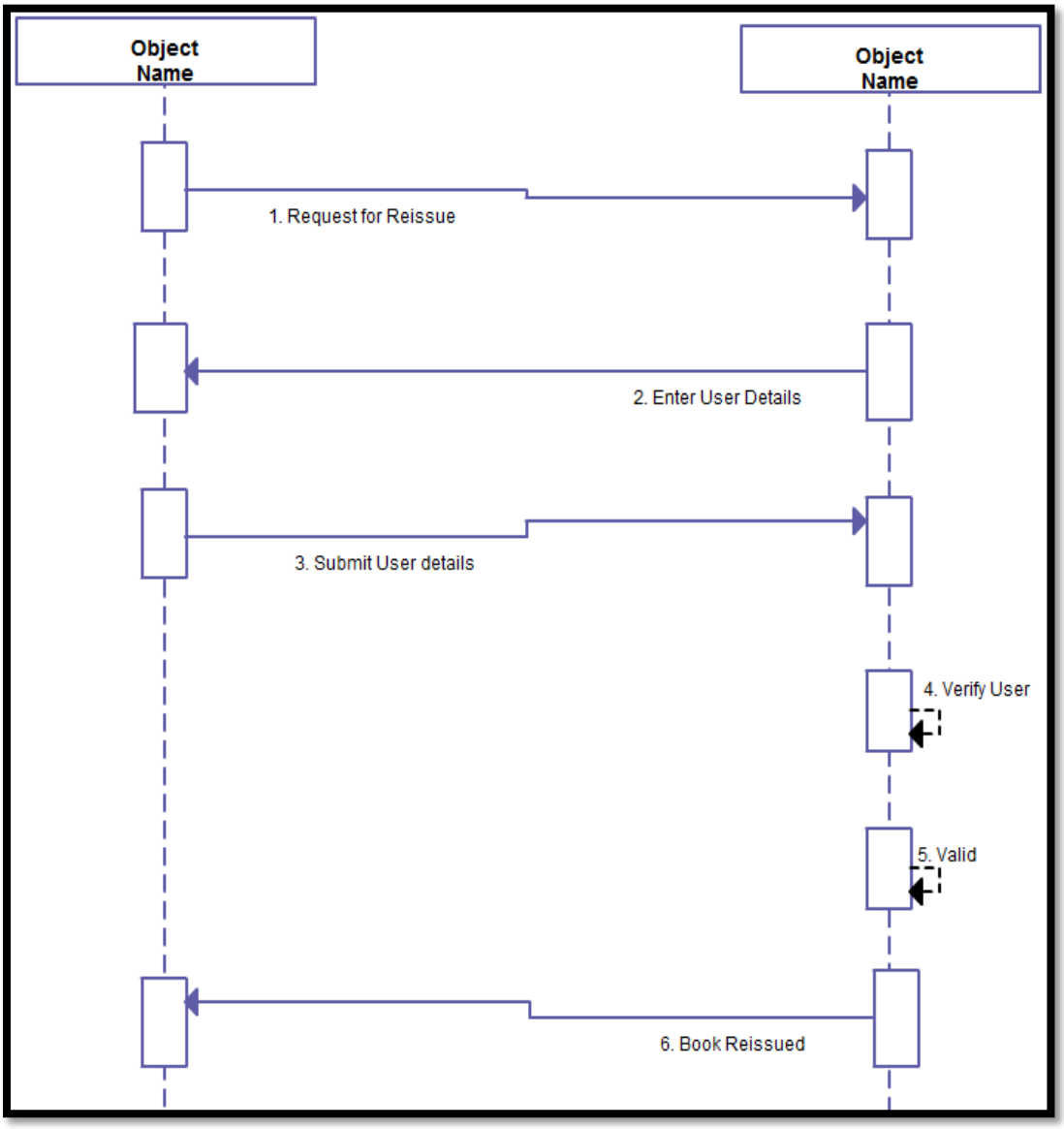

Figure 4.58 Reissue Normal Case

Exceptional Case

Figure 4.59 shows the exceptional case for book reissue.

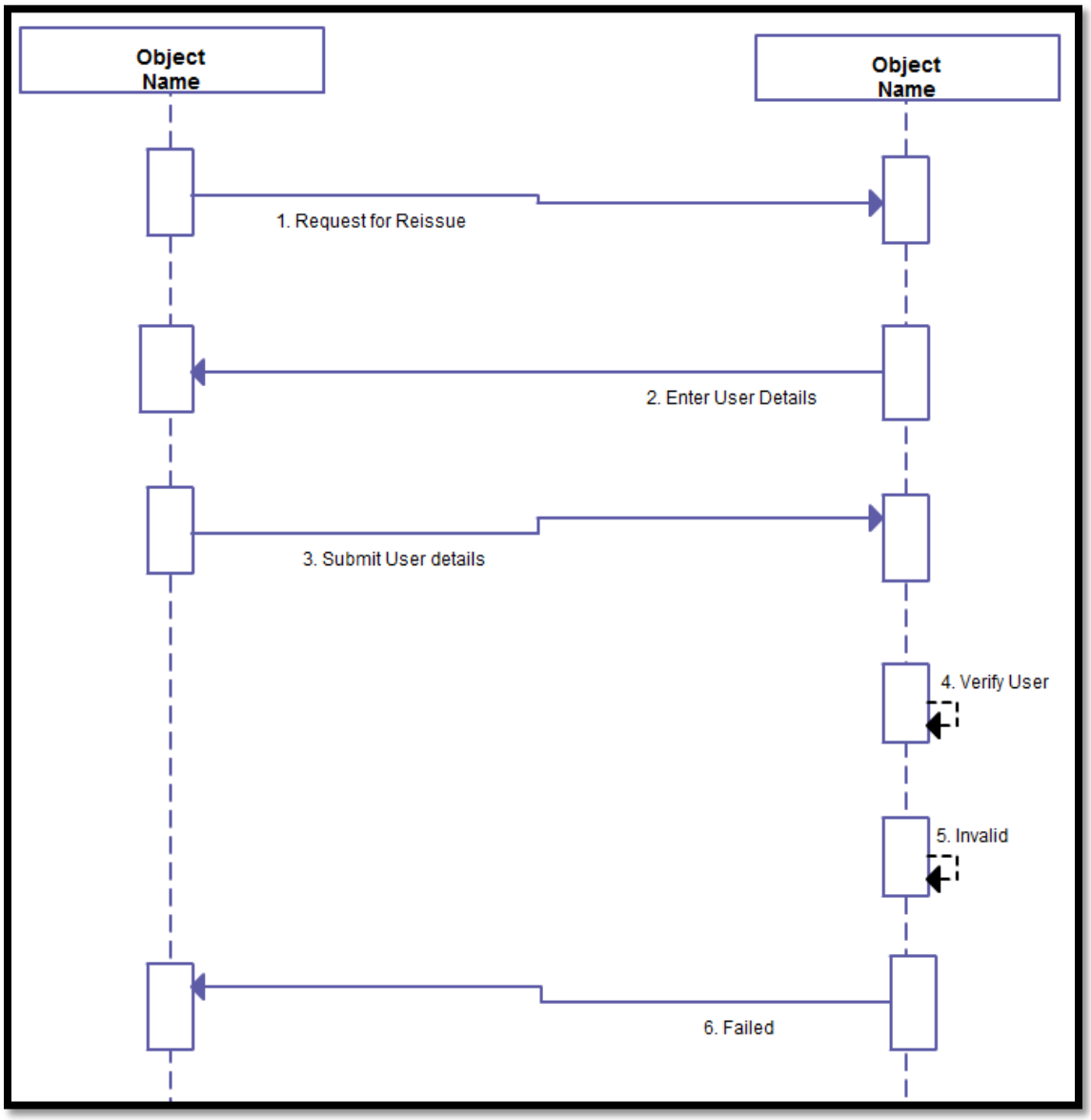

Figure 4.59Reissue Exceptional Case

Add New Items

Figure 4.60 shows the case for adding new items.

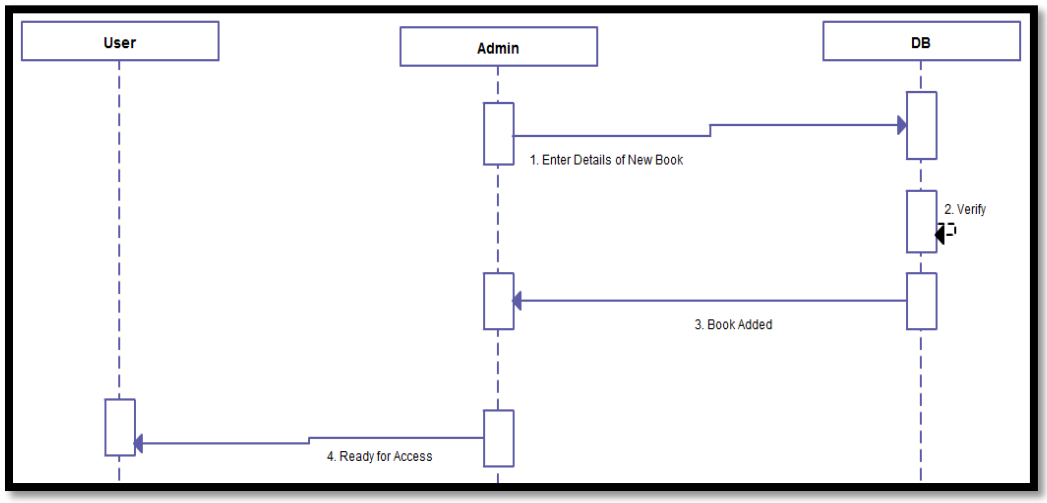

Figure 4.60 Add New Items

Remove Book

Figure 4.61 shows the normal case for removing a book.

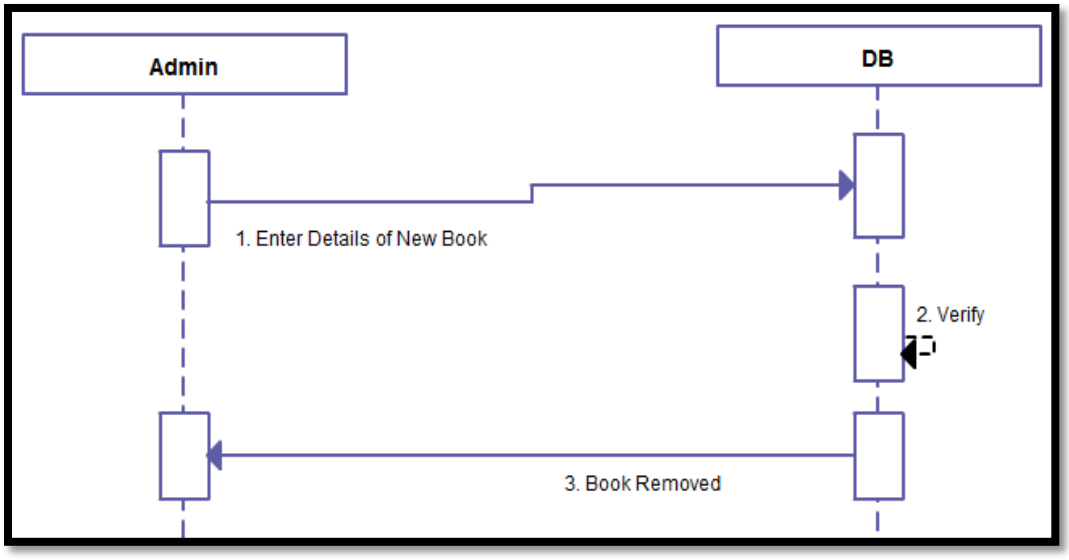

Figure 4.61 Remove Book

Book Reservation

Figure 4.62 shows the normal case for book reservation.

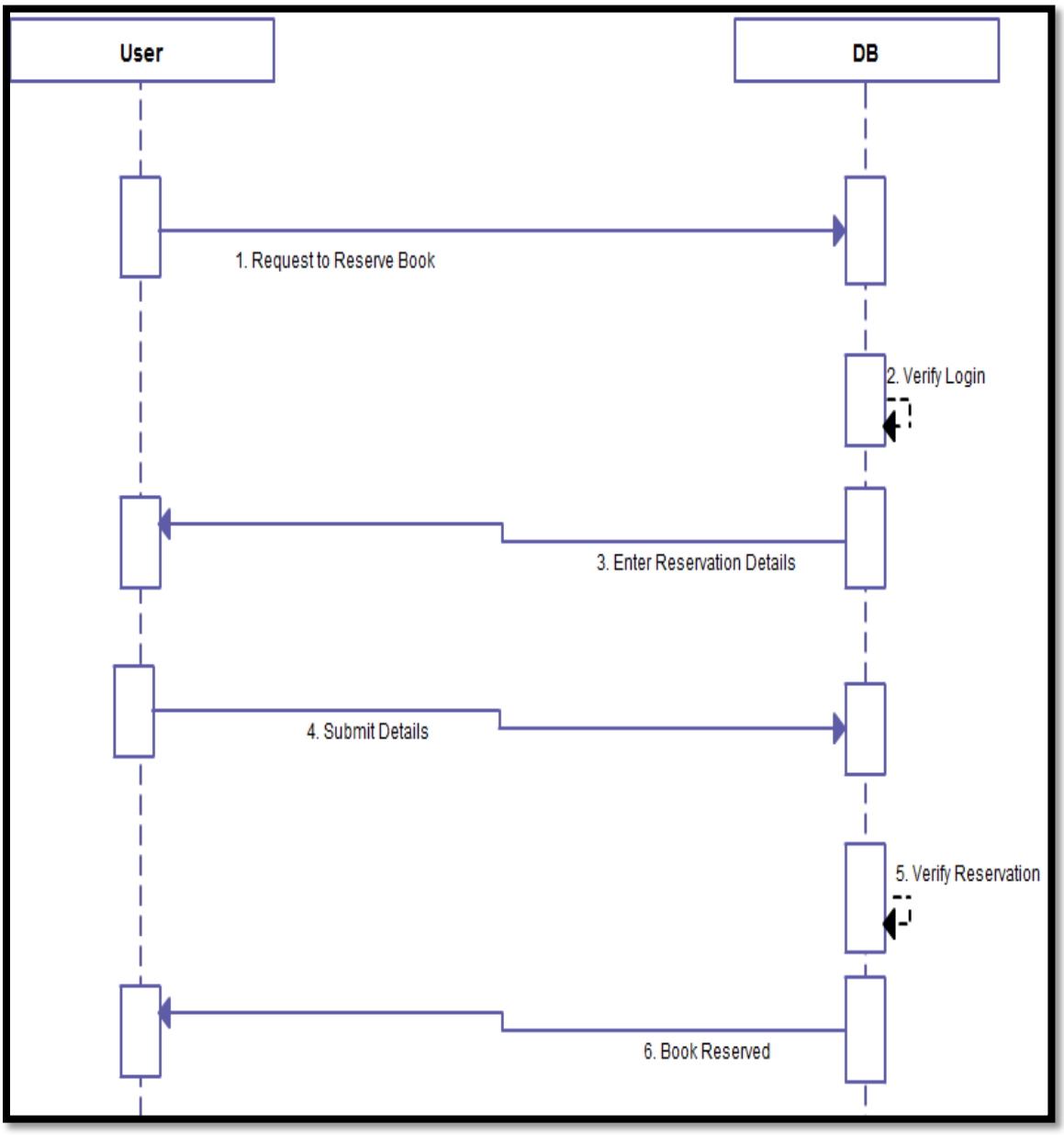

Figure 4.62 Book Reservation

Change Password

Figure 4.63 shows the case for change of password.

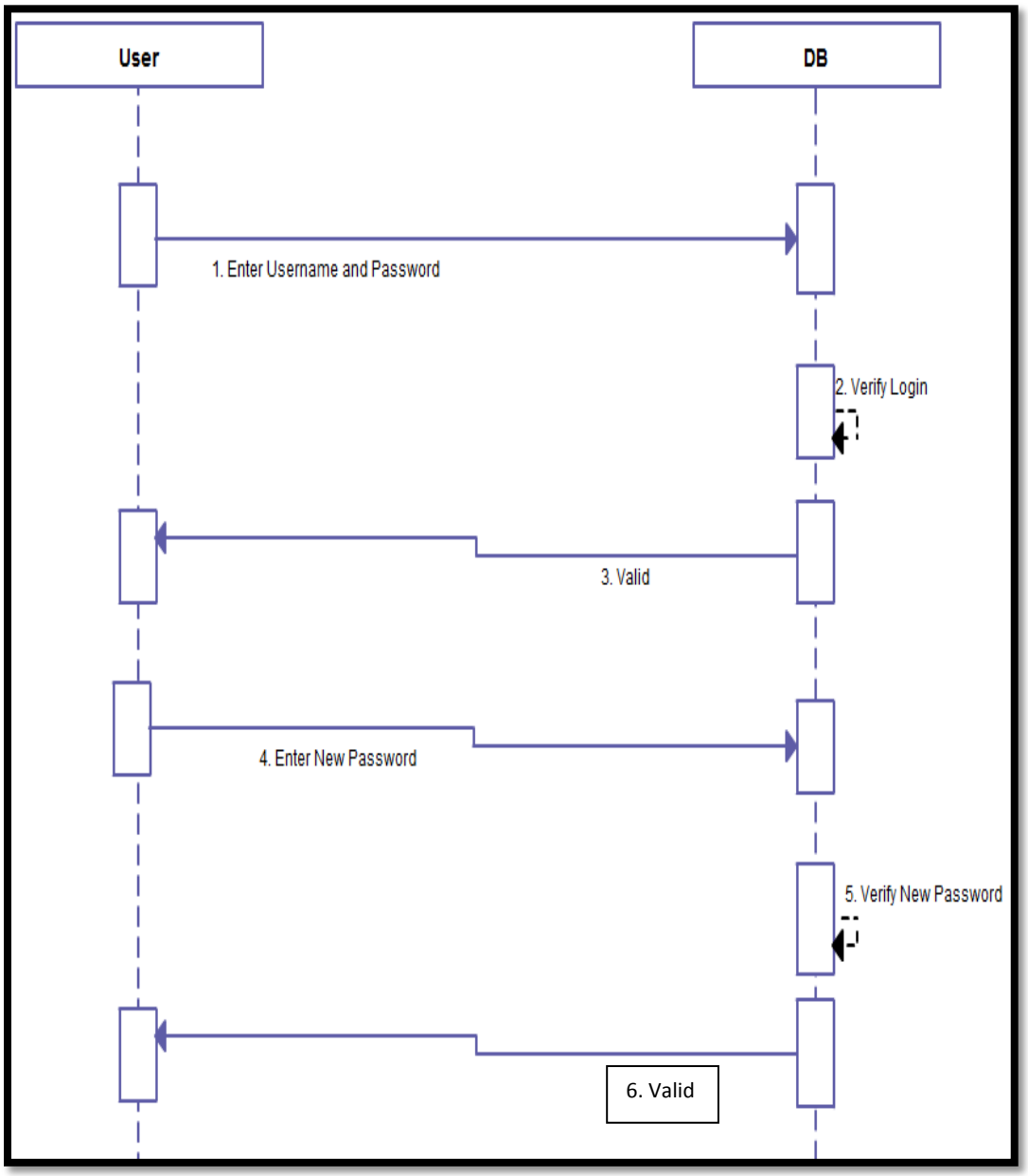

Figure 4.63 Change Password

If Password Forgotten

Figure 4.64 shows the case when a user has forgot the password at the time of login into the system.

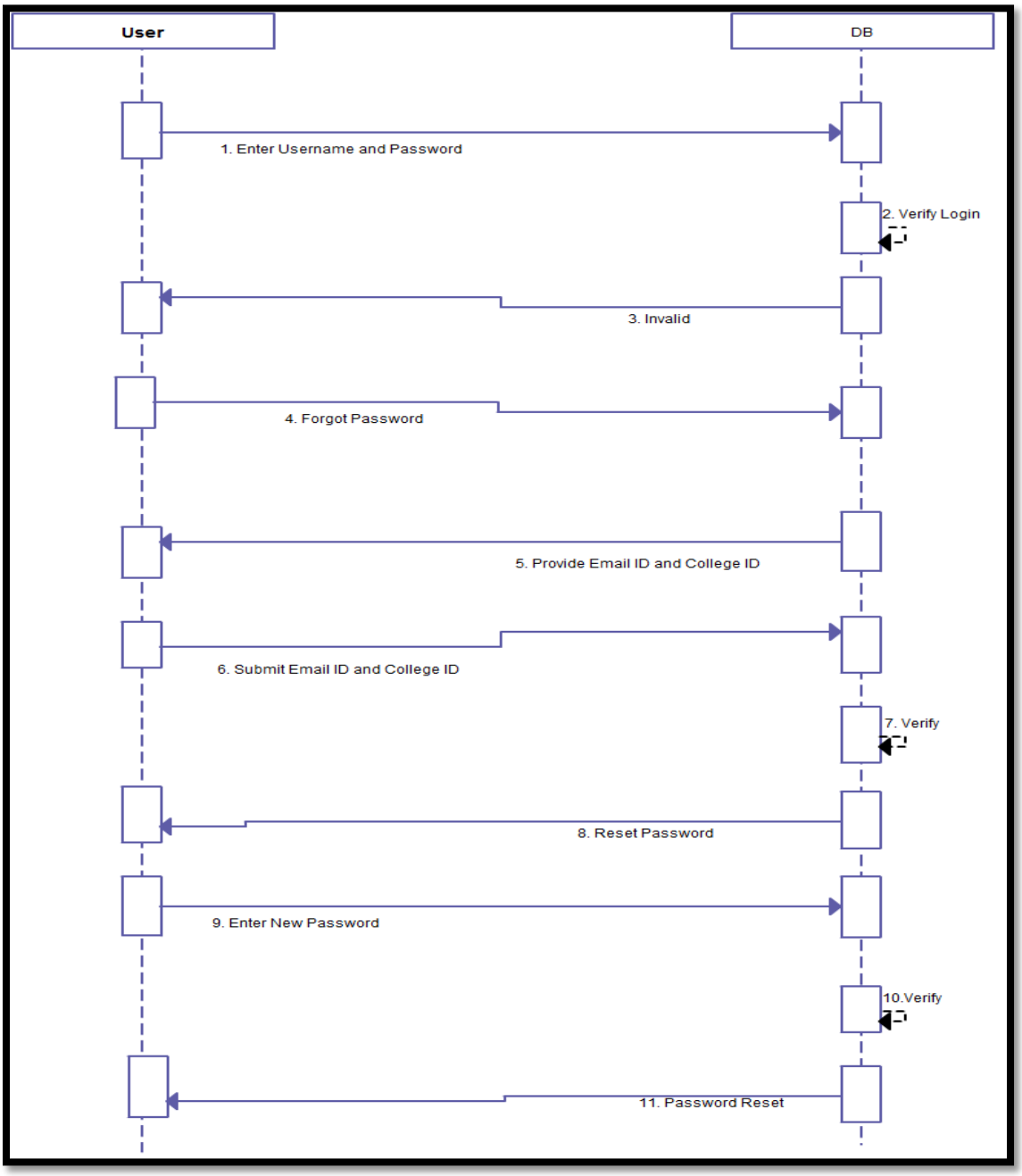

Figure 4.64 If Password Forgotten

Update Item / User

Figure 4.65 shows the case for updating an item or user.

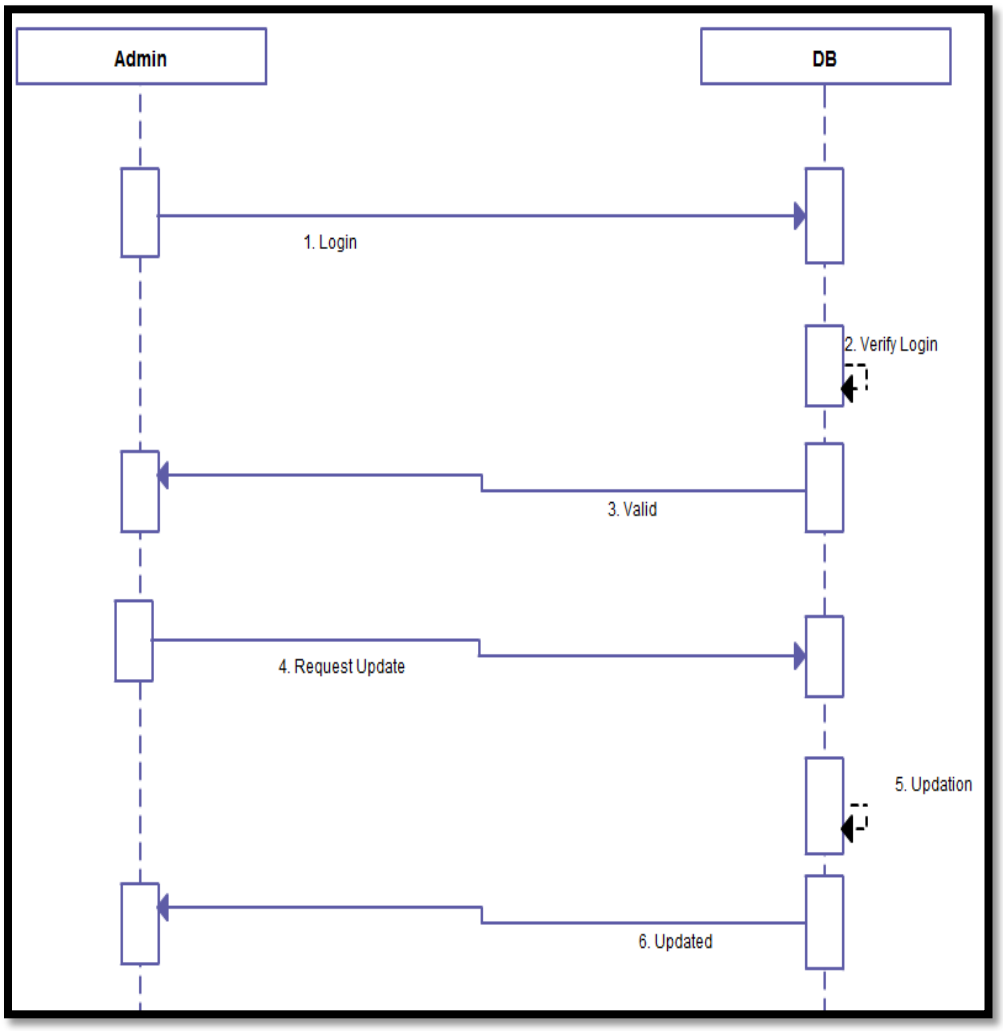

Figure 4.65 Update Item / User

Search Profile: Normal Case

Figure 4.66 shows the normal case for profile search.

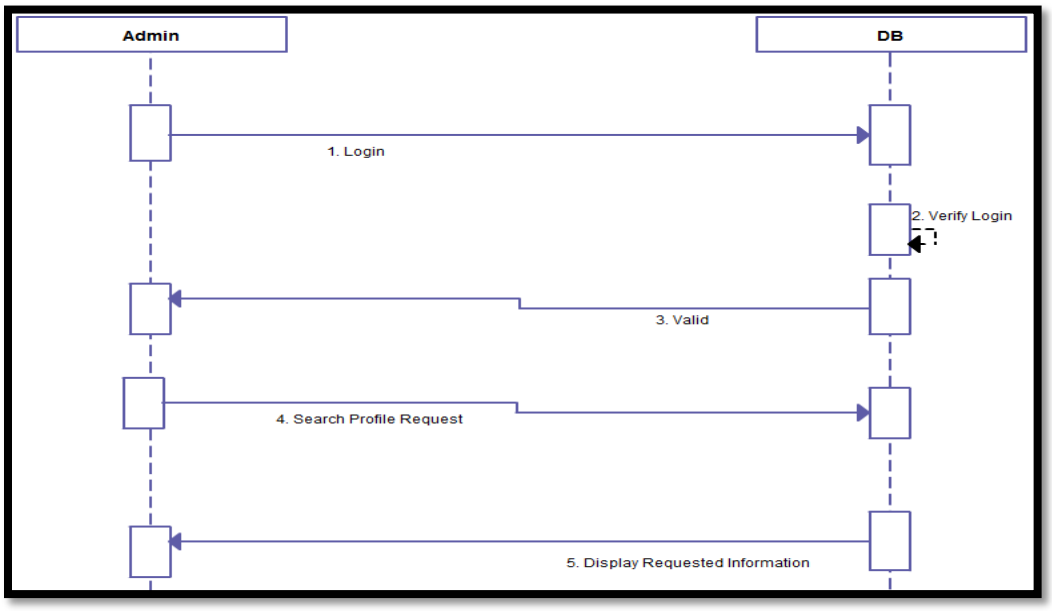

Figure 4.66 Search Profile Normal Case

Exceptional Case 1

Figure 4.67 shows the exceptional case 1 profile search.

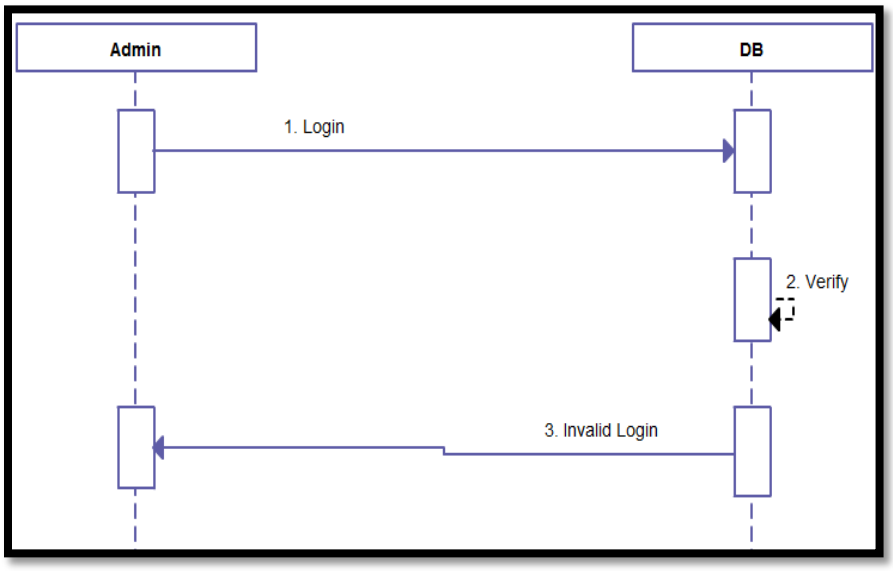

Figure 4.67 Search Profile Exceptional Case1

Exceptional Case 2

Figure 4.68 shows the exceptional case 2 for profile search.

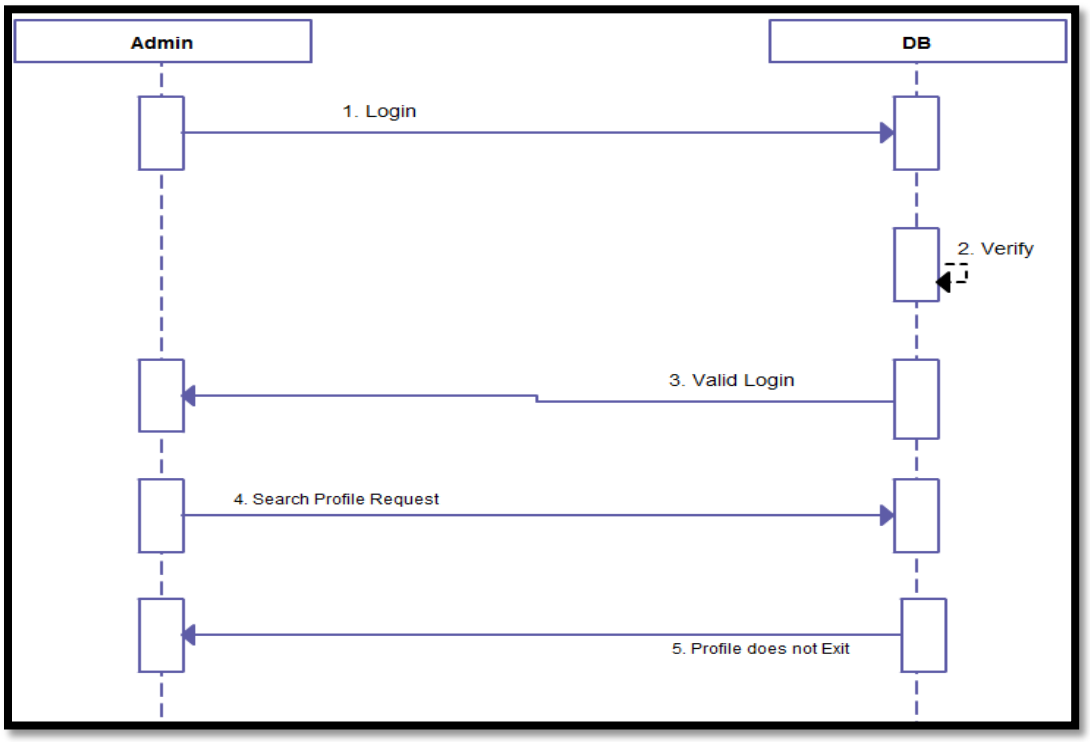

Figure 4.68 Search Profile Exceptional Case2

4.2.2.4. Use Case Realization

Its purpose is to represent a graphical overview of the functionality provided by the system in terms of actors, their goals and dependencies between those use cases. The main purpose of use case diagram is to show what system functions are performed for which actor. Figure 4.67 shows the overall use case diagram for the system.

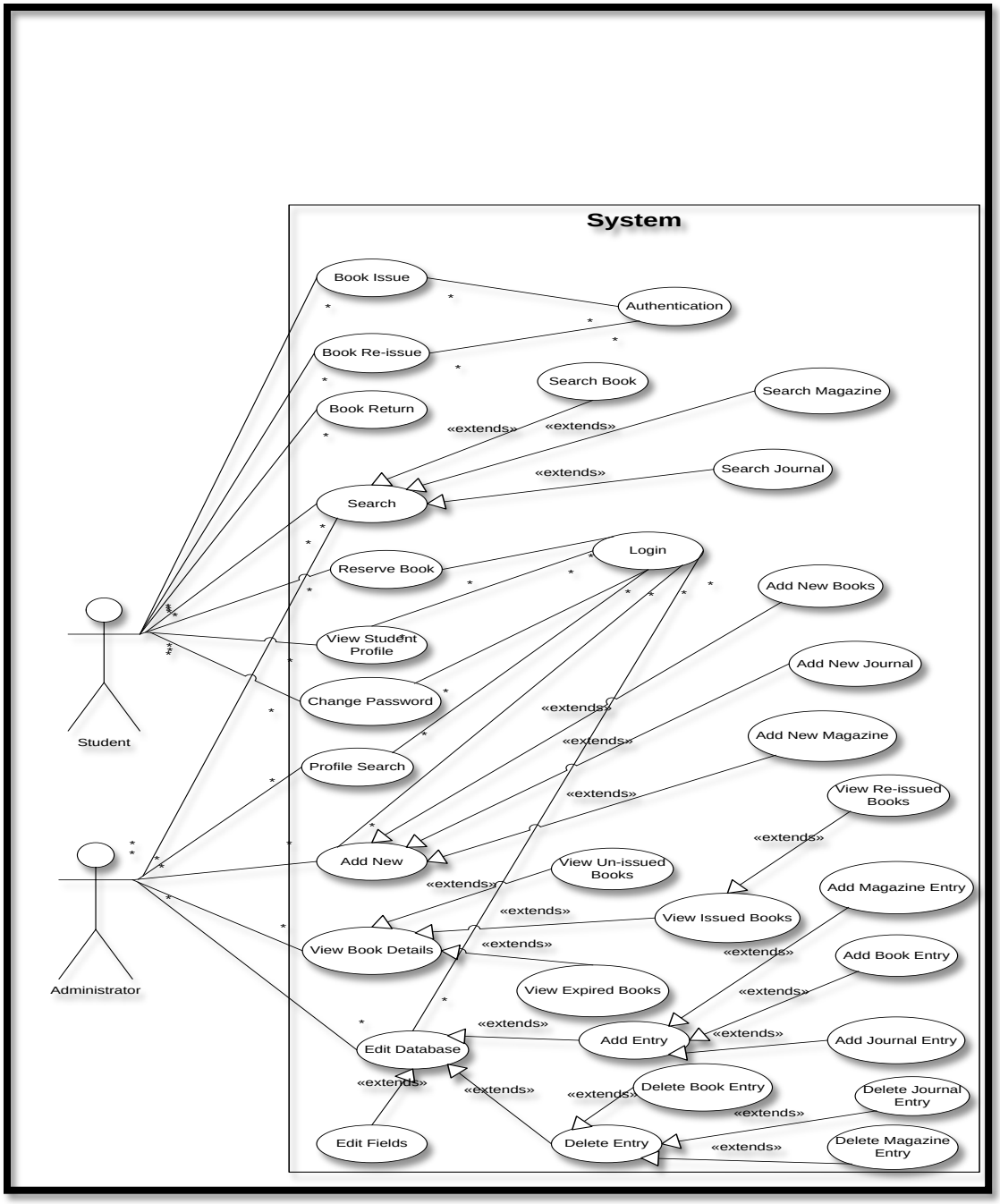

Figure 4.69 System Use Case Diagram

4.2.3 Implementation Document for Library Management System

The implementation document follows a format as specified by IEEE and it is given in detail in this section.

4.2.3.1 Introduction

This section consists of the purpose and overview of the system as well as other details.

4.2.3.1.1 Purpose

To create a desktop application and web portal that would enable users to remotely access the library management and security system (RFID Based) based on their dedicated access level.

4.2.3.1.2 System Overview

A flexible and user friendly program that would incorporate the basic library management and security functions involving automated performance via RFID system and the software being compatible with the existing system.

4.2.3.1.2.1 System Description

The library management and security system would implement the basic functions that are required for the above mentioned system. The software category further divided into different parts which consist

ofOnline Database for users and books catalogue, a desktop application that would provide the user with an interface to access the LMSS (Library Management and Security System) based on their authorization levels and a Web Portal that would create an access link from the desktop application to the online databases.

The hardware category consists of an UHF RFID Reader (Which would be responsible for the host communication and reader-tag interactions), RFID passive tags (GEN2 18000-6c supported) and 2x Antennas (One is for close range proximity detection and other for long range detection for security).

4.2.3.1.2.2 Assumptions and Constraints

According to the progress of our work, the estimated time of completion for our project is assumed to be within the first week of May 2012. Following are some factors that would govern the outcome of our project. Budget: Since our project is RFID based therefore it requires a considerable amount of monetary resource. Till now we have estimated the budget required for the project to be under 90,000 PKR. Resource Availability: The schedule can be affected by the availability of the required resources which in our case are, the

specified RFID components which are not available in Pakistani markets, also the selection of programming methodology and skills require considerable time since the initial learning of a programming language is a difficult task.Complexity involved in interfacing the RFID components with the host system and the understanding of the ISO standard for RFID systems.

4.2.3.1.2.3 System Organization

The Major part of our system is distributed into different areas which include both the software and hardware, but the primary work is centralized on the desktop application the acts as an interface between the hardware and online database. Following are some parts that have been organized in order to give an overview of the system.

Primary system components

RFID equipment (includes reader, tags, antennas, cables and interfacing connections)

The Desktop application should be properly interfaced with the hardware through the standard interfacing protocols.

Internet Access

Online database and a web portal to access it.

System Working

After the successful programming of the desktop application, we link it to the online database via Web Portal which we have reserved online, and check the operation of the application. After the first step we then assemble the hardware that is the RFID equipment. The RFID system consisting of the mentioned components is then connected to the host system, on which the desktop application is running and ensured that the reader is operating as desired.

Now when the tagged object is brought in the vicinity of the reader antenna, the tag identification number is automatically read and is used as a parameter for updating, searching and notifying the detection of the tagged objects which in our case are the books and the user ID card. Based on the type of tag, two different function routines are executed.

If the tagged object is a student ID card, the system would automatically be directed towards the user database from which it would compare the already available student ID or would prompt the admin to add the data of the given user. The ID card is also provided at the time of issuing a book or for billing purposes.

In case the tagged object is a book, the system can perform the following actions based on the status of the RFID tag in the book's database and application. If the books is not issued, the system would detect it is a theft attempt with the help of the long range antenna and would notify the concerned staff. If it is to be issued, the individual would present his RFID card and the corresponding book which would update the status of the book in the online database and hence disable the security function on that specific book. Once issued, the user database is also updated with the date, time and the relevant book that has been issued.

When the book is to be returned, the user simply passes it over the proximity antenna attached to the reader, which then changes the status of the book to "Available" and at the same time the application also calculates the overdue fine if the book has been returned late. Figure 4.68 shows the RFID library management system.

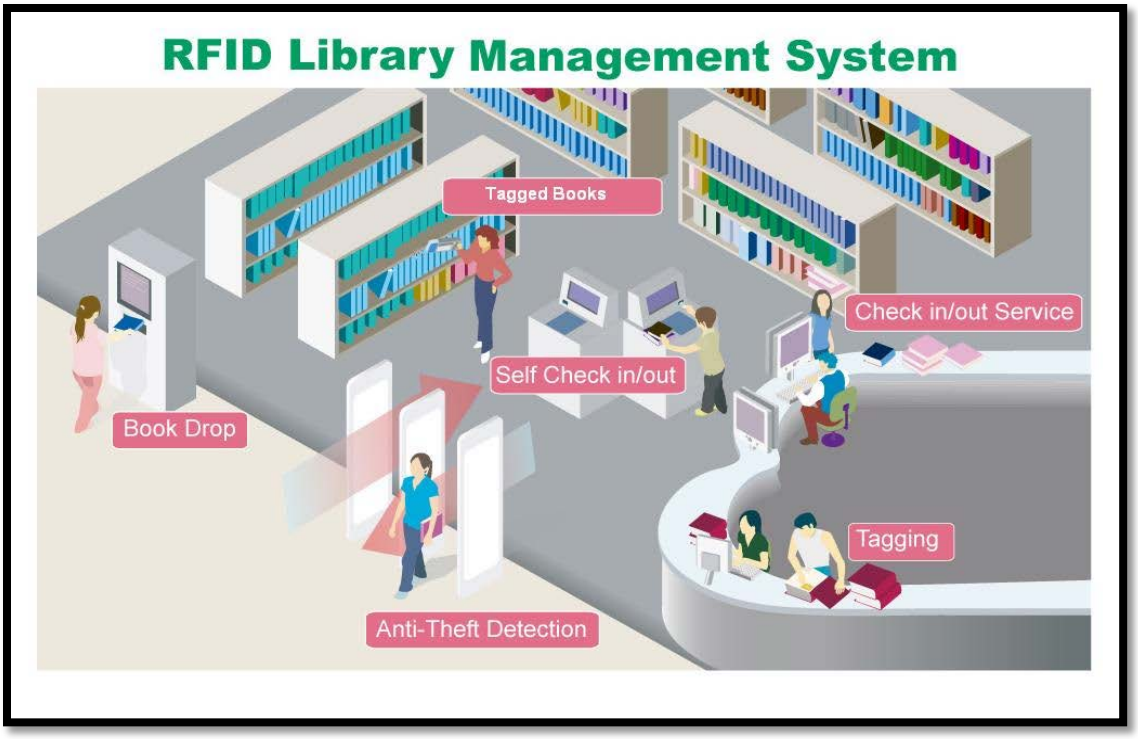

Figure 4.70 Overview of Library Management

Physical Database Design

The database has been divided into a number of tables to minimize the redundancy of information and make it easy for us to design various tables in the front end of the website. We have two independent systems i.e. the “Library Management System” and the “Parking System”. Both of these systems have two separate DBs therefore we will explain the tables in them separately:

Library Management System Database Design

This portion will include the brief design of the Library Management System database. Below we have mentioned each table as it is present in the database with brief description of its operation. More details relating to each column and its contents can be found in Appendix-A of this document.

Users Record Table

Fields	Data Type
RFID_Id	Varchar (244)
Name	Varchar (244)
Reg_Num	Int (12)
Department	Varchar (244)
Course	Varchar (244)
Email	Varchar (244)
Mobile_No	Varchar (244)

Address	Varchar (244)
Fine	Int (12)

Table 4.1 Users Record Table

The Table 4.1 will help the users in the process of logging in and will also store all data related to the user. The Email, Password and Type field will specifically help the user to log in and will also determine if he is a student, faculty member or library admin. All instances in DB where the RFID of user is mentioned, it will be returned to this table to get additional information about the user.

Fine List Table

Fields	**Data Type**
RFID_Id	Varchar (244)
Amount	Int
Return_Date	Date
Rfid_id_Books	Varchar (244)

Table 4.2 Fine List Table

The Table 4.2 will be used to fine students if there is a late return of book. The expected return date and the actual return date are compared to fine the student.

Reserved Books list Table

Fields	Data Type
RFID_User	Varchar (244)
ISBN	Varchar (244)
Res_Num	Int (10)
RFID_Book	Varchar (244)
Res_Date	date

Table 4.3 Reserved Book List Table

The Table 4.3 will carry information about users who have reserved books using the web portal. RFID of user and book will help to make tables in the website that display complete information.

Issued Books list Table

Fields	Data Type
I_User	Varchar (244)
RFID_Book	Varchar (244)
Issue_date	date
ISBN	Varchar (244)
I_time	Time
R_time	Time
ER_Date	Date
OD_Date	Date

Table 1.4 Issued Books List Table

The Table 4.4 will have the list of users who have issued books from the library. Once the look is returned, the corresponding entry from

this table will be deleted and a new entry with return date will be made in the log files table instead.

Books list Table

Fields	**Data Type**
RFID	Varchar (244)
ISBN	Varchar (244)
Name	Varchar (244)
Edition	Int (244)
Author	Varchar (244)
Call_Num	Varchar (244)
Category	Varchar (244)
Y_Pub	Varchar (244)
Publisher	Varchar (244)

Department	Varchar (244)
B_Price	Int (244)
B_From	Varchar (244)
Add_Dates	Date
Rem_Dates	Date
Rem_Reasons	Varchar (244)
Keywords	Varchar (244)
I_Allowed	Varchar (244)
I_Bits	Bit(1)
T_Bits	Bit(1)

Table 4.5 Books List Table

The Table 4.5 will have all info about the book. This info will be displayed in different tables depending upon the requirement of the data that has to be displayed on the website.

Magazines list /Journals & Periodicals/Thesis/Digital Media Tables

Fields	**Data Type**
RFID	Varchar (244)
ISBN	Varchar (244)
Name	Varchar (244)
Author	Varchar (244)
Edition	Int (244)
Category	Varchar (244)
Y_Pub	Varchar (244)
Publisher	Varchar (244)
Department	Varchar (244)

B_Price	Int (244)
B_From	Varchar (244)
Add_Dates	Date
Rem_Dates	Date
Rem_Reasons	Varchar (244)
Keywords	Varchar (244)
I_Allowed	Varchar (244)
I_Bits	Bits (64)
T_Bits	Bits (64)

Table 4.6 Magazine/Journal/Thesis/Digital Media Table

The Table 4.6 will have all data about thesis, journals, magazines and Digital media.

Log Files Table

Fields	**Data Type**
RFID_User	Varchar (244)

RFID_Book	Varchar (244)
I_Date	Date
R_Date	Date
O_Days	Int (24)

Table 4.2Log Files Table

Log files as shown in Table 4.7 will have all data pertaining to books that have been issued and then returned. This table will be used to constitute issued books list as well as the history table.

4.2.3.2 Login to Desktop Application

When a user logs into the desktop application, an algorithm is followed this is as under:

4.2.3.2.1 Algorithm

Algorithm is a logical sequence that an activity follows when it is invoked. The flow diagram for login to desktop application is shown in the Figure 4.71

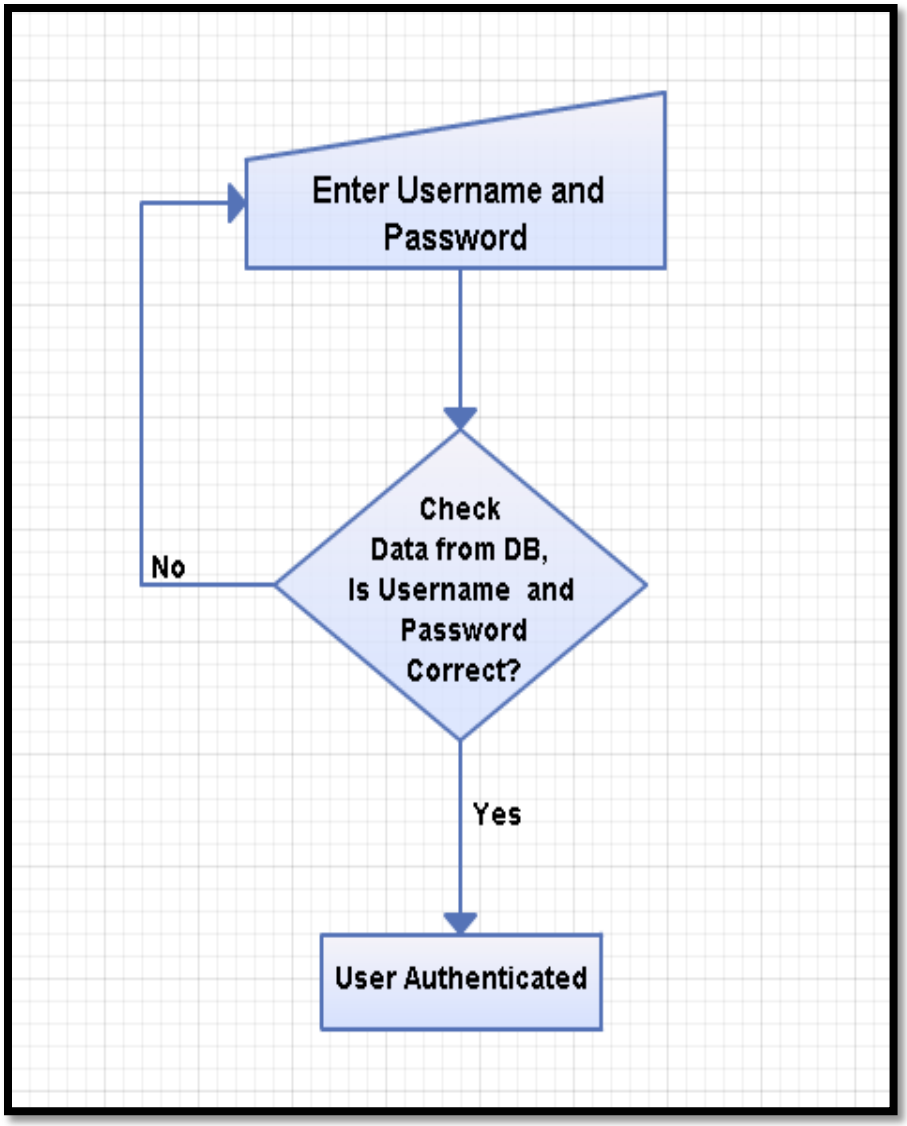

Figure 4.71 Flow Diagram for Login to Desktop Application

4.2.3.2.2 Code

```
string user;

string pass;


user = this.tb_user.Text;
```

```
pass = this.tb_pass.Text;

MySqlConnection conn = newMySqlConnection("Database = latest ; Server = localhost ;
Port = 3306 ; UserID = root");

string query = "SELECT * FROM user_record WHERE Email = " +"'" + user + "'" + "AND
password = " + "'" + pass + "'";

MySqlCommandcmd = newMySqlCommand(query, conn);
conn.Open();

MySqlDataReaderrdr = cmd.ExecuteReader();

while (rdr.Read())
            {
string username = (string)rdr["user"];
string password = (string)rdr["pass"];
user_db = username;
pass_db = password;

            }
rdr.Close();
conn.Close();
if (string.Compare(user_db, user) == 0 &&string.Compare(pass_db, pass) == 0)
            {
success = true;
            }
else
```

```
            {
success = false;
            }
```

4.2.3.3 Connection of System

When the system is turned on, connection is to be established with the reader.

4.2.3.3.1 Algorithm

Algorithm is a logical sequence that an activity follows when it is invoked. The flow diagram for connection of system is shown in the Figure 4.72

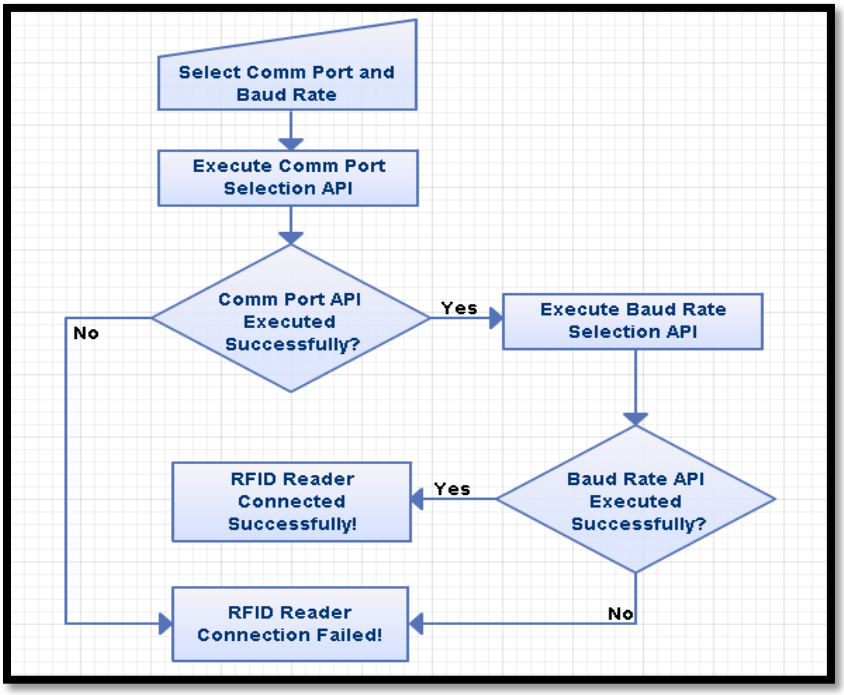

Figure 4.72 Flow Diagram for Connection System

4.2.3.3.2 Code

```
privatevoidConnectButton_Click(object sender, EventArgs e)
      {
byte linktype = 1;
stringcom_port = this.COMBox.Text; ;
byte ret = Demo.ReaderDll.OpenReader(refm_hCom, linktype, com_port);

if (ret == 0)
         {
stringnBaudStr = this.BaudBox.Text;
intnBaud = Convert.ToInt16(nBaudStr);

bytebret = Demo.ReaderDll.SetBaudRate(m_hCom, nBaud);

if (bret == 0)
            {
ConnLabel.Text = "Connection Successful!";
Thread t3 = newThread(loop);
t3.Start();
            }
         }
else
         {
ConnLabel.Text = "Connection Failed!";

         }
      }
```

4.2.3.4 RFID Library Management System Algorithm

Library management system has many functions and for their execution, an algorithm is needed.

4.2.3.4.1 Algorithm

The flow diagram for the library system is shown in the figure 4.73

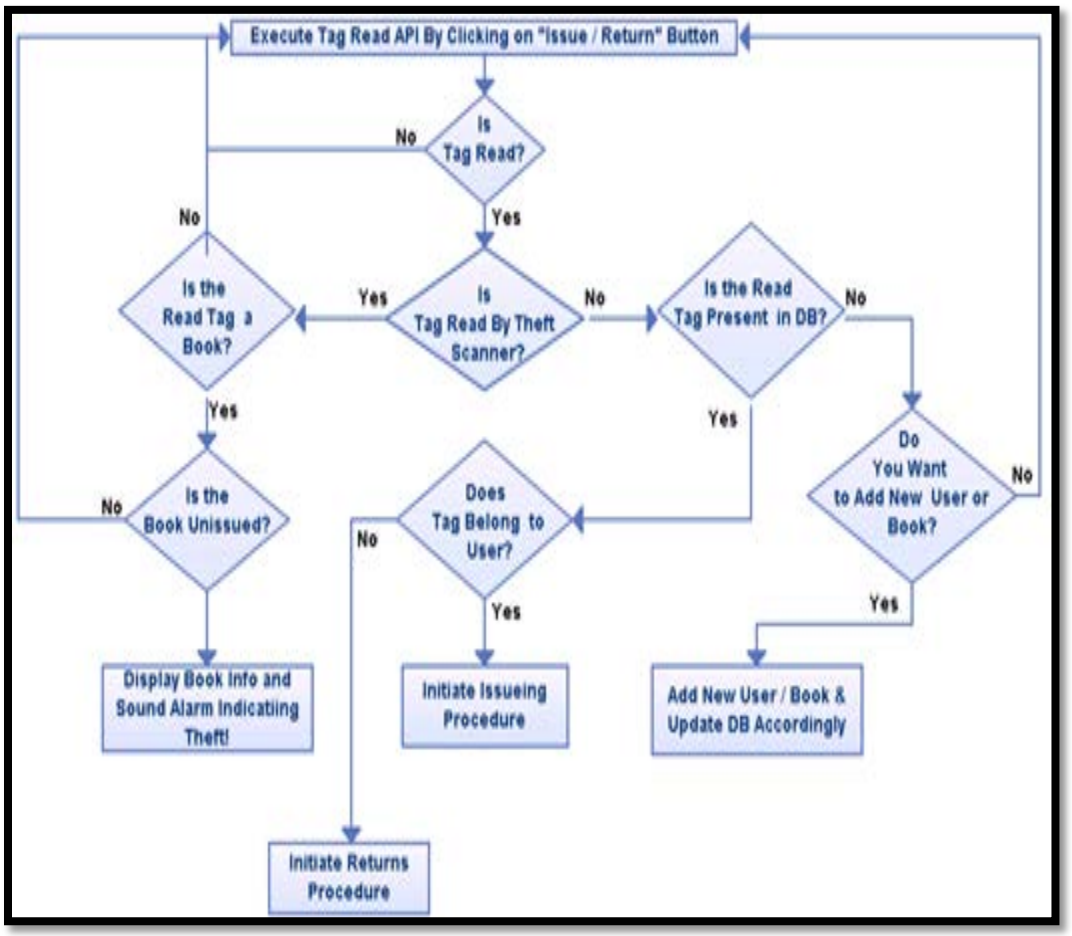

Figure 4.73 Flow Diagram for Library System

4.2.3.4.2 Code

```
privatevoid button4_Click(object sender, EventArgs e)
        {
byte[] tid;
byte[] temp = newbyte[12];
tid = newbyte[15];
int count = 0;
bytenTagType = 4;
byte iden1 = 1;
byte[] t = newbyte[1];

int loop1 = 0;
readallow = 0;

while (loop1 < 10)
           {
              iden1 = Demo.ReaderDll.MultipleTagIdentifyEx(m_hCom, nTagType, ref
count, tid);
if (iden1 == 0)
              {
readallow = 1;
break;
              }
loop1++;
           }
readallow = 1;

if (iden1 == 0 && count > 0)
```

```
            {


t[0] = tid[1];
string data1 = BitConverter.ToString(t);
if (data1 == "02")
                {
int x = 0;


while (x <= 11)
                    {
temp[x] = tid[x + 3];
x++;
                    }


lbl_timer.Visible = true;
lbl_showcard.Visible = false;
                    RFIDIP = BitConverter.ToString(temp);
//MessageBox.Show("RFIDIP");
//MessageBox.Show(RFIDIP);
MySqlConnection conn = newMySqlConnection("Database = latest ; Server = localhost ;
Port = 3306 ; UserID = root");
string query = "SELECT identity FROM search WHERE rfid_id = " +"'" + RFIDIP + "'";
MySqlCommandcmd = newMySqlCommand(query, conn);
conn.Open();


MySqlDataReaderrdr = cmd.ExecuteReader();
while (rdr.Read())
                    {
```

```
username = (string)rdr["identity"];
                }

rdr.Close();

//STARTING ISSUEING PROCESS CODE FROM THIS LINE

if (username == "user")
                {

                    label3.Text = "ISSUEING INITIATED";
MySqlConnectioncs = newMySqlConnection("Database = latest ; Server = localhost ; Port
= 3306 ; UserID = root");

cs.Open();
btn_issue.Visible = false;
dataGridView1.Show();

                    query = "SELECT * FROM user_record WHERE RFID_Id = " +"'" +
RFIDIP + "'";
MySqlDataAdapter da = newMySqlDataAdapter(query, cs);
DataTabledataTable = newDataTable();
da.Fill(dataTable);
                    dataGridView1.DataSource = dataTable;

cs.Close();

//checking hte limit of isuuedboooks to the current user
```

```
                query = "SELECT Num_books FROM user_record WHERE RFID_Id = "
+"'" + RFIDIP + "'";
cmd = newMySqlCommand(query, conn);

int limit = (int)cmd.ExecuteScalar();

conn.Close();
if (limit >= 3)
                {
                    label4.Visible = true;
                    label4.Text = "You have already issued 3 books!";
dataGridView2.Show();
//show all the rebook records that are isuued to the user
MySqlConnection cs1 = newMySqlConnection("Database = latest ; Server = localhost ;
Port = 3306 ; UserID = root");
cs1.Open();
                    query = "SELECT * FROM issued_books WHERE I_User = " +"'" +
RFIDIP + "'";
MySqlDataAdapter da1 = newMySqlDataAdapter(query, cs1);
DataTable dt1 = newDataTable();
da1.Fill(dt1);
                    dataGridView2.DataSource = dt1;
cs1.Close();

                }
else
                {
btn_proceed.Visible = true;
```

```
btn_cancel.Visible = true;
                    label4.Visible = false;
MessageBox.Show("Please Place a Book on RFID Scanner for Issueing and Press Proceed!");
timer1.Start();
                }

            }

//STARTING RETURNING CODE FROM THIS LINE

elseif (username == "book")
            {

                label3.Text = "RETURNING INITIATED";
btn_no.Visible = true;
lbl_timer.Visible = false;
lbl_showcard.Visible = false;


MySqlConnectioncs = newMySqlConnection("Database = latest ; Server = localhost ; Port = 3306 ; UserID = root");
cs.Open();
dataGridView3.Show();
                query = "SELECT Name, ISBN, Category, Edition, Department, Author FROM books_list WHERE RFID = " +"'" + RFIDIP + "'";

MySqlDataAdapter da = newMySqlDataAdapter(query, cs);
```

```
DataTabledt = newDataTable();
da.Fill(dt);
                    dataGridView3.DataSource = dt;
cs.Close();
conn.Close();
this.label4.Visible = true;
                    label4.Text = "Are you sure you want to return a book?";
btn_Return.Visible = true;


                }


else
                {
                    label1.Text = "Do you want to make a new entry?";
btn_book.Visible = true;
btn_user.Visible = true;
                 }
              }
           }
        }
```

4.2.4 Software Requirement Specification Document (SRS) for Parking System

The SRS Document follows a proper format as defined by ieee. This document specifies the use cases and the requirements of the software to be designed.

4.2.4.1 Introduction

This section includes a brief overview of the purpose and scope of the software and a brief introduction of various terminologies that are used in the SRS document.

4.2.4.1.1 Purpose

The purpose of this document is to present a detailed description of RFID based parking system. It will explain the purpose and features of the system, the interfaces of the system, what the system will do, the constraints under which it must operate and how the system will react to external stimuli. This document is intended for both the administrators and the users of the system.

4.2.4.1.2 Scope

This software will provide a parking system for vehicle. It will consist of an unattended parking barrier with controlled parking privilege accesses. This system will minimize human interaction and will increase the overall efficiency.

This system will provide access to only authorized vehicle. The system will use a desktop application and an online database to check whether vehicle trying to enter the college premises exists in the database or not. The barrier will allow only those vehicles to enter which already exists in the database. The administrator can also access the system remotely via an online portal.

4.2.4.1.3 Definitions, Acronyms, and Abbreviations

MySql is a relational database management system (RDBMS) that runs as a server and provides access to multiple users to a number of databases. Desktop Application is a stand-alone application in a desktop or laptop computer. It does not require the Web browser to run. Online Portalis a vehicle by which we can gain access to a number of services. A website is itself a destination. Database is an organized collection of data in digital form. Use Case Diagram is a diagram

representing interactions between an actor and a system, to achieve a goal. The actor may be a human or an external system.

Class Diagram is a static structure that defines the structure of a system by representing system's classes, their attributes, operations and the relationships among different classes.ERD is the relationship among different entities of the system in a top-down manner.

4.2.4.1.4 References

IEEE SRS format, Project Specification Requirement by Global Marketplace, www.google.com, www.wikipedia.com

4.2.4.1.5 Overview

The next chapter, the Overall Description section, of this document gives a brief description of the functionality of the product. The third chapter, Requirements Specification section, of this document is written primarily for the users and describes the technical details of the functionality of the product.

These sections of the document describe the same software product but are intended for different users.

4.2.4.2 Overall Description

This section consists of the system diagram, the external hardware and software required in the system.

4.2.4.2.1 Product Perspective

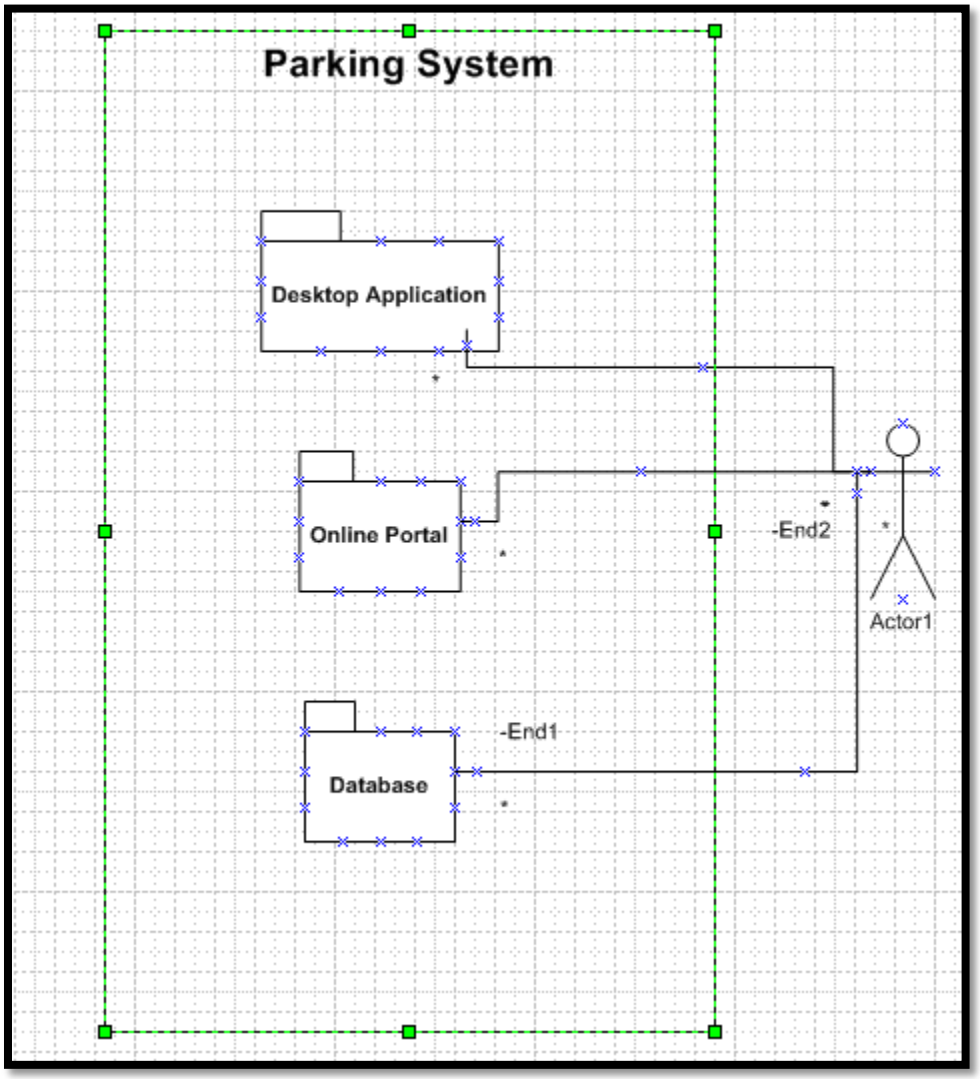

Figure 4.74 System Diagram for Parking System

The parking system consists of one actor and one cooperating system as shown in the Figure 4.74. The actors include the Administrator who can access the system either through the Internet or the Desktop Application. A link also exists to the Database.

4.2.4.2.2 External Hardware

Client Hardware consists of a host workstation and user workstations. Host Workstation which is the computer connected to the RFID reader and is used by the administrator.User Workstations which are the computers used to access the system over the Internet from a remote location.Networkused is the Internet which is a global network used by administrators and the users to access the system.

4.2.4.2.3 External Software

Desktop Application which is a software running on the computers, used by the administrator for manual management of the system. Desktop application is controlling the motor for moving barrier up and down. Online Portal which is a website used to access the system over the Internet.

4.2.4.2.4 External Systems

Security Gateway is an external antenna (long range) with a server at the backend for protecting against theft of unissued books.Book Management Unit which is a small range antenna for reading tags of books to be issued or to be returned.

4.2.4.2.5 User Characteristics

The administrator is expected to be Internet literate and be able to use a search engine. The administrator should also be to handle the database and run MySql queries and knowhow of visual studio.

4.2.4.3 Product Function

This section explains the use cases for the parking system and their details.

4.2.4.3.1 Administrator Use Case System Diagram

Figure 4.75 shows the administrator use case diagram. It shows the various ways in which an administrator can interact with the software system.

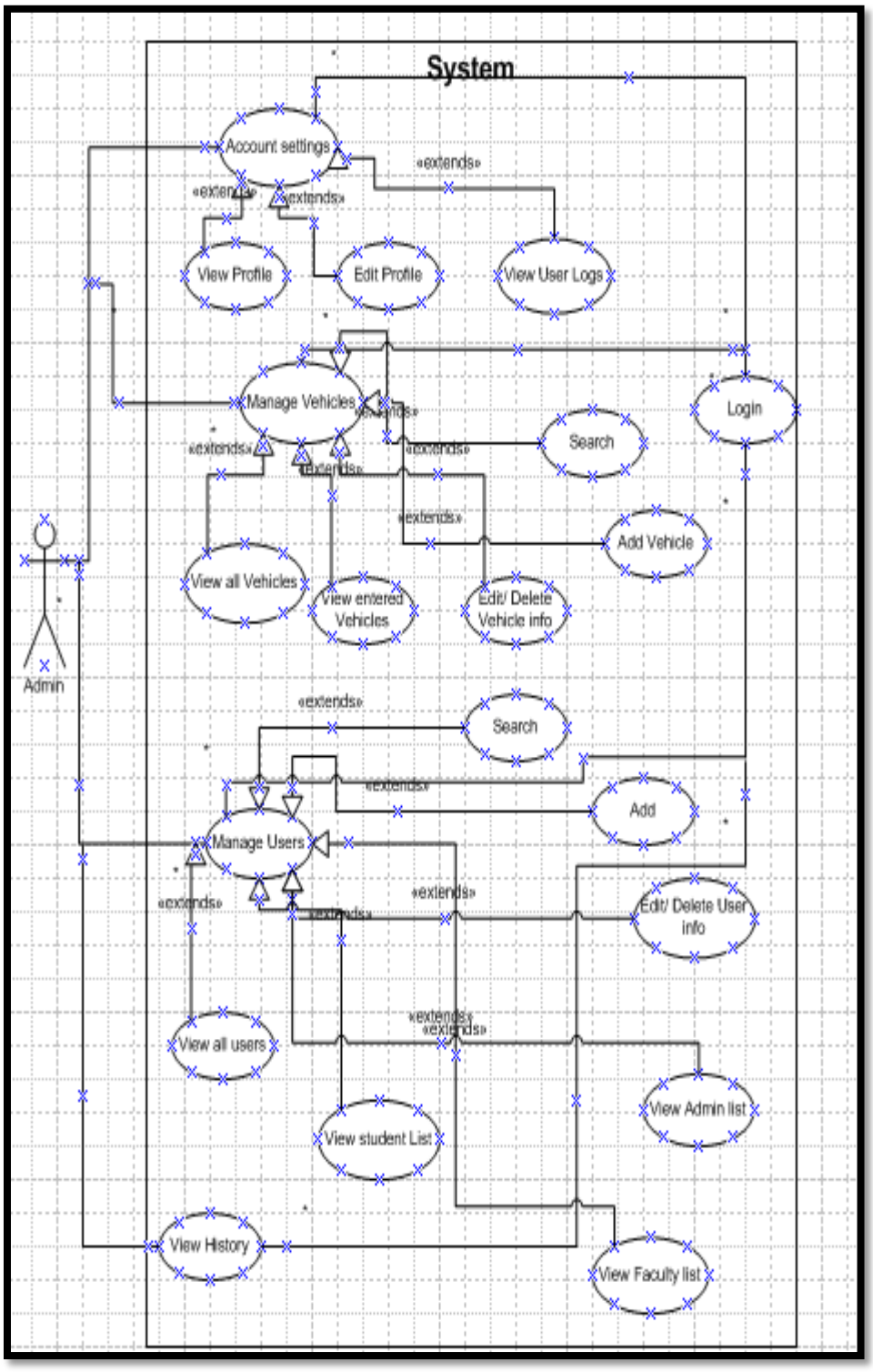

Figure 4.75 System Use Case Diagram

4.2.4.4 Specific Requirements

These requirements consist of functional as well as non functional requirements which are discussed in detail in this section.

4.2.4.4.1 Functional Requirements

This section explains the use cases for different actors if the system. It specifies the requirements and procedure for executing each use case.

4.2.4.4.1.1 Administrator Use Case

Use cases for the administrator are discussed in detail in this section along with the diagrams and other details.

Name: Account Settings via Website

Goal

The Administrator aims to view his/ her profile and edit. Admin can also view user logs

Diagram

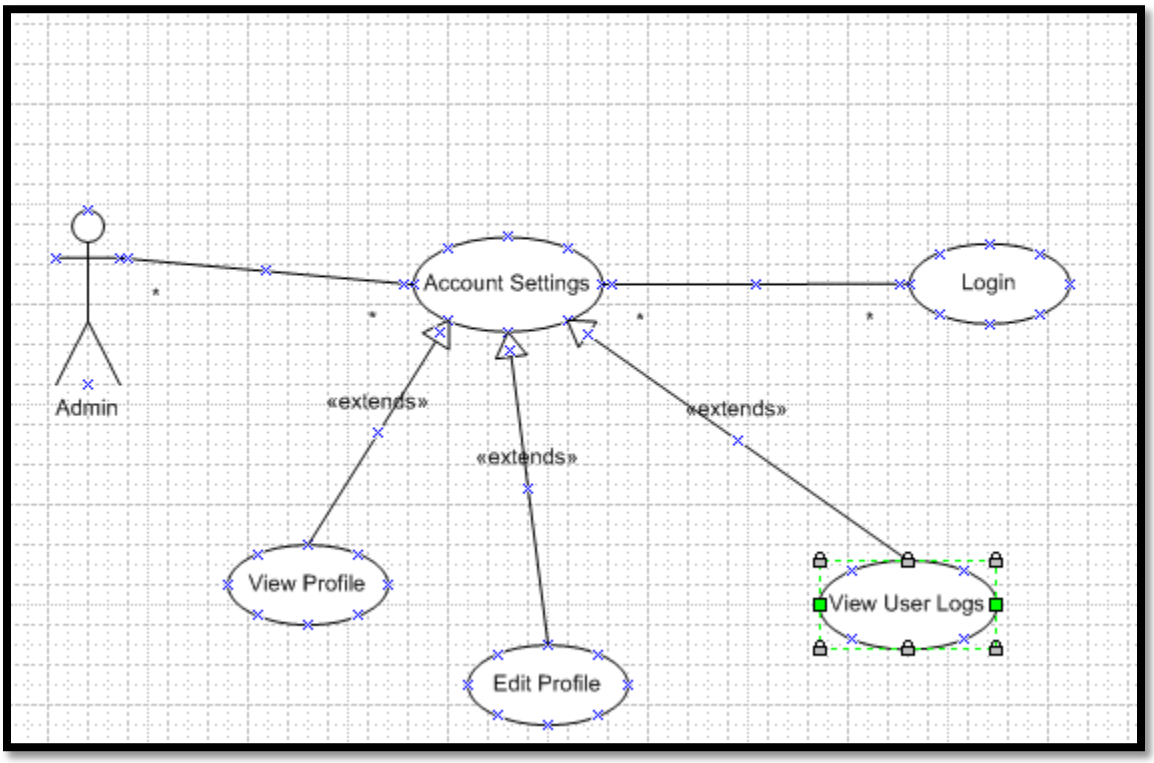

Figure 4.76 Use Case1

Preconditions

The web is displayed with grids for searching.The Administrator has a valid username and password.The Administrator is logged into the web portal.

Basic Course

Use case begins when the Administrator accesses the online portal.Administrator uses his login name and password to log into the

system.Administrator chooses to view account settings. Admin can view his/her profile, can edit it and can also view user logs. Use case ends with the results being displayed

Alternate Course

If the administrator enters incorrect username or password, a message appears that incorrect username or password is entered.

Post conditions

The details of the user are displayed by the system.

Actors

Administrator

Name: Manage Vehicle via Web

Goal

Administrator aims to manage vehicles

Diagram

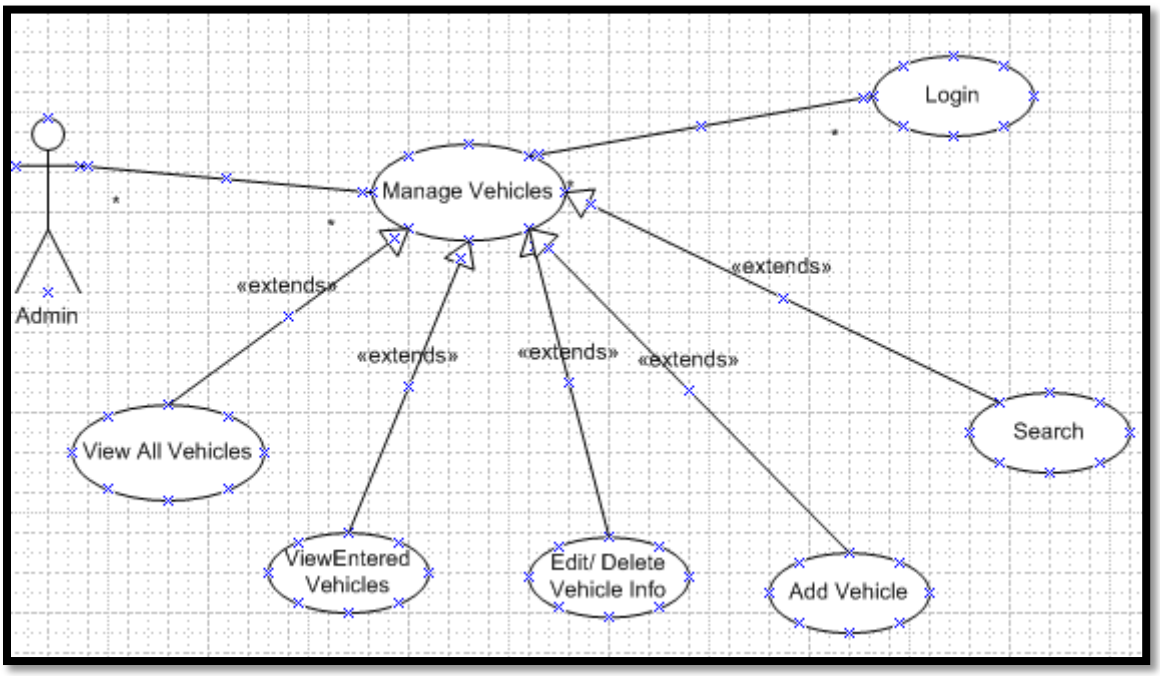

Figure 4.77 Use Case2

Pre-Conditions

The Web is displayed with grids for searching.The Administrator has a valid username and password.The Administrator is logged into the system.

Basic Course

Use case begins when Administrator accesses the website.Admin uses his username and password to login.Admin clicks on ‘manage vehicles’ to view, edit, add and search vehicles.Use case ends with results being displayed by the system.

Alternate Course

If the administrator enters incorrect username or password, a message appears that incorrect username or password is entered.

Post Conditions

Results are displayed by the system

Actors

Administrator

Name: Manage Users via Website

Goal

The Administrator aims to manage users

Diagram

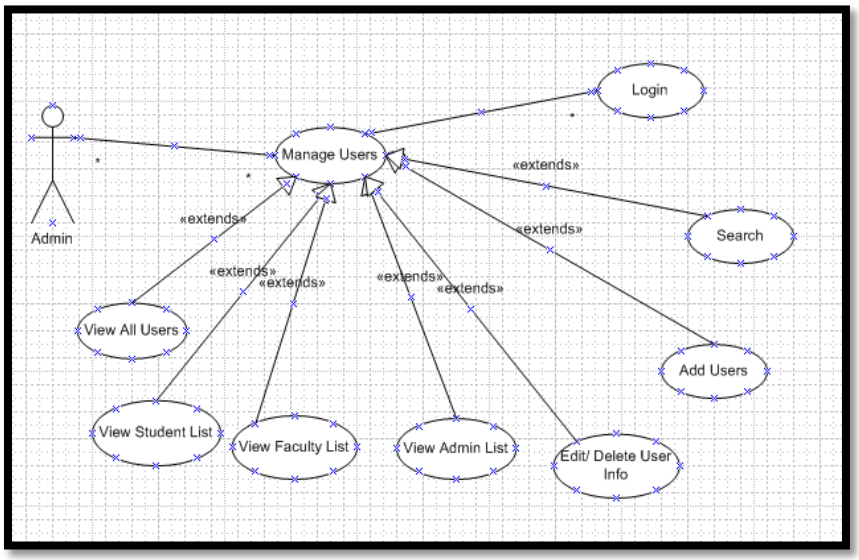

Figure 4.78 Use Case3

Pre-Conditions

The Web is displayed with grids for searching.The Administrator has a valid username and password.The Administrator is logged into the system.

Basic Course

Use case begins when the Administrator accesses the online portal.Administrator uses his login name and password to log into the system.Administrator chooses manage users. Admin can view all users, edit user information, add new user and search user. Use case ends when the result is displayed by the system.

Alternate Course

If the administrator enters incorrect username or password, a message appears that incorrect username or password is entered

Post Conditions

Desired results displayed by the system

Actors

Administrator

Name: View History

Goal

Admin aims to view history using online portal

Diagram

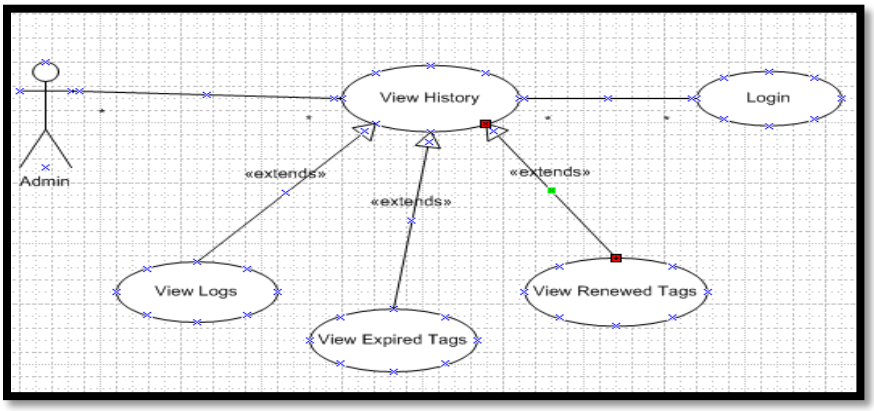

Figure 4.79 Use Case4

Pre-Conditions

The Web is displayed with grids for searching.The Administrator has a valid username and password.The Administrator is logged into the system.

Basic Course

Use case begins when Admin accesses the website. Admin uses his username and password to login. Admin chooses to view logs, expired tags and renewed tags. Use case ends with results displayed by the system

Alternate Course

If the administrator enters incorrect username or password, a message appears that incorrect username or password is entered and clicks “Forgot Password” if the administrator has forgotten his password.

Post Conditions

The desired results are displayed by the system

Actors

Administrator

4.2.4.4.1.2 System Class Diagram

Class diagram shows different classes in the software design. The class diagram is shown in the Figure 4.78 as below:

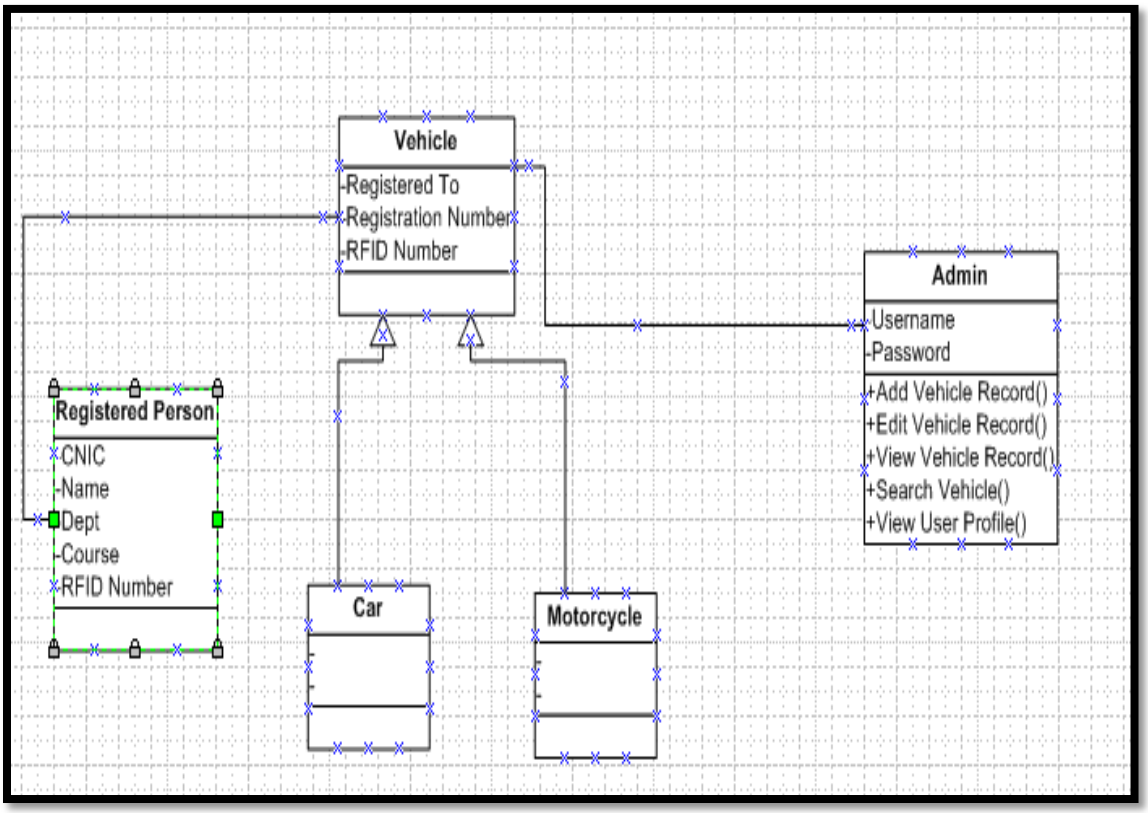

Figure 4.80 Class Diagram

4.2.4.4.2 Non-Functional Requirements

Non functional Requirements include specifications of the system on which the software is run.

4.2.4.4.2.1 System Specifications

Processor: 1.3MHz, RAM: 256 MB, Hard-Disk: 200MB, Windows XP, 7, Vista

4.2.4.4.2.2 Accessibility

The system software will be installed on the administrator's PC and PC will contain an online MySql database.

4.2.4.4.2.3 Speed of the Reader

The minimum reading speed of the reader should be 5 RFID tags.

4.2.4.4.2.4 Security

The server hosting the online database and Web Portal will have their own security to prevent unauthorized access.

The PC on which the Desktop Application resides will have its own security. Only the Administrator will have physical access to the program on it and the application will be locked until it is logged in.

Only the Administrator can view and open the database and no one else can edit the database.

4.2.5 Design Specification Document for Parking System

The SDD Document follows a proper format as defined by IEEE. This document specifies the activity diagrams and sequence diagrams for various interactions with the software.

4.2.5.1 Introduction

This section includes a brief overview of the purpose of the software and a brief introduction of various terminologies that are used in the SDD document.

4.2.5.1.1 Purpose

The purpose of this document is to provide a detail description of the design and functions of a parking system using RFID technology. It will explain how the system will interact with users and external environment. It will highlight the factors which will affect the system performance. This document is for project manager, project team and development team. This document will verify that the current document meets all the requirements contained in the system model as well as the requirements desired by the customer.

4.2.5.1.2 Glossary

RFID is Radio Frequency Identification; DB is Database for Users and Books; User includes both students and faculty of college or university; Tag Code is a unique code of a tag to identify it; Activity Diagram is used to specify the basic steps in any procedure.

4.2.5.1.3 Reference

www.wikipedia.org, www.google.com

4.2.5.1.4 Overview of Document

The overall system design objective is to provide an efficient design that will reduce system complexity and will make the implementation easy. This document will provide interface design models that are consistent, user friendly and will provide straightforward transitions through various system functions.

4.2.5.2 Data Dictionary

This section includes the description about the different objects of the software engineering cycle.

4.2.5.2.1 Objects

4.2.5.2.1.1 Registered Person Object

Registered person is a separate class that has specific attributes. Hence it is also an object in the software design.

Description

This object contains information such as user's full name, CNIC, course, department, RFID tag code etc. The tag code serves as a primary key in the database.

Usage

This object is used to allow entry of users in college premises

4.2.5.2.1.2 Vehicle Object

Vehicle is a separate class that has specific attributes. Hence it is also an object in the software design.

Description

This object contains vehicle type, vehicle registration and name of the person it is registered to etc. The vehicle is either car or bike

Usage

The system will allow the entry of the authenticated vehicle.

4.2.5.2.1.3 Administrator Object

Administrator is a separate class that has specific attributes and methods. Hence it is also an object in the software design.

Description

This object contains information such as username, password etc. Password is the primary key

Usage

This object adds new vehicles, can view and edit vehicle record, search vehicle and view user profile

4.2.5.2.3 Class Diagram

The class diagram as in Figure 4.81 shows the system's classes, their attributes and the relationship between classes.

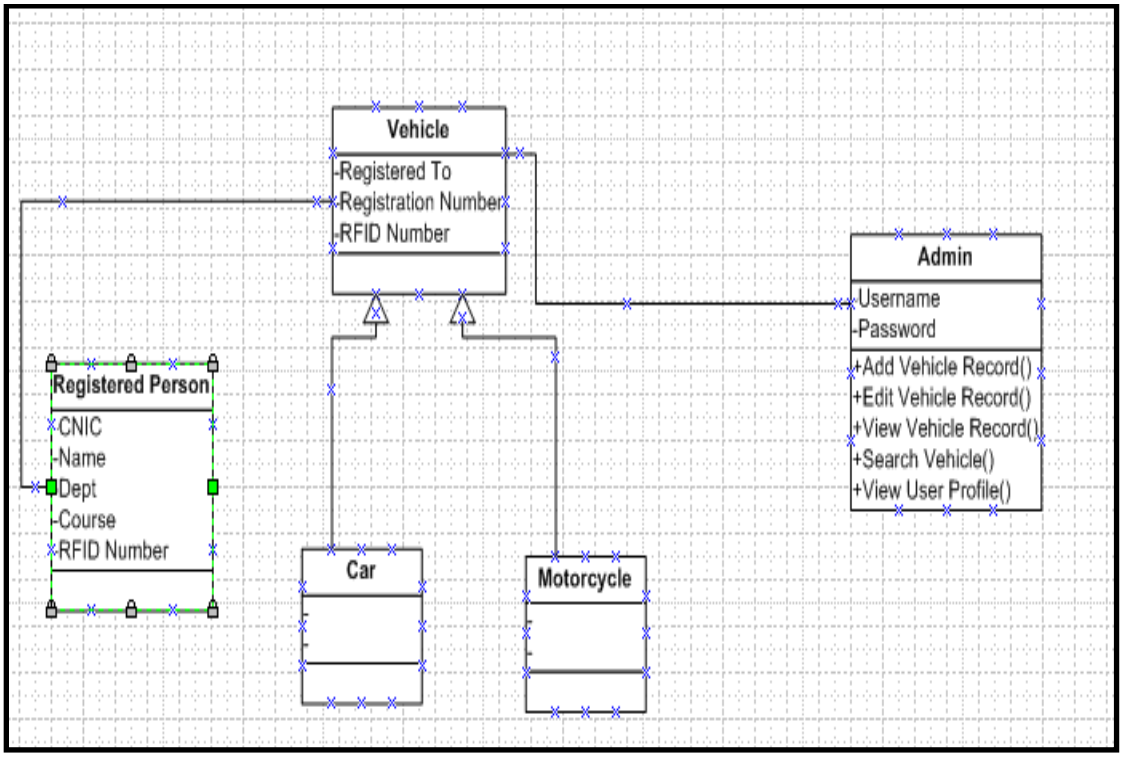

Figure 4.81 Class Diagram for Parking System

4.2.5.3 Architectural Design

This system will be capable of performing the basic functions required for parking system. Each function is explained below:

Adding a User

Admin enters the RFID number of user card and the desired information using the website to add new user to database

Adding a Vehicle

Admin enters the RFID number of vehicle and the desired information using the website to add new user to database

Editing the database

The administrator will be able to edit the database that is whenever there is any change in details of users or vehicle, the database will be updated.

4.2.5.3.1 Activity Diagram

Activity diagram is used to show the specific activities involved in a procedure. Each procedure is completed only after the completion of a series of activities.

Account Settings

Figure 4.82 shows the activity diagram for the account settings.

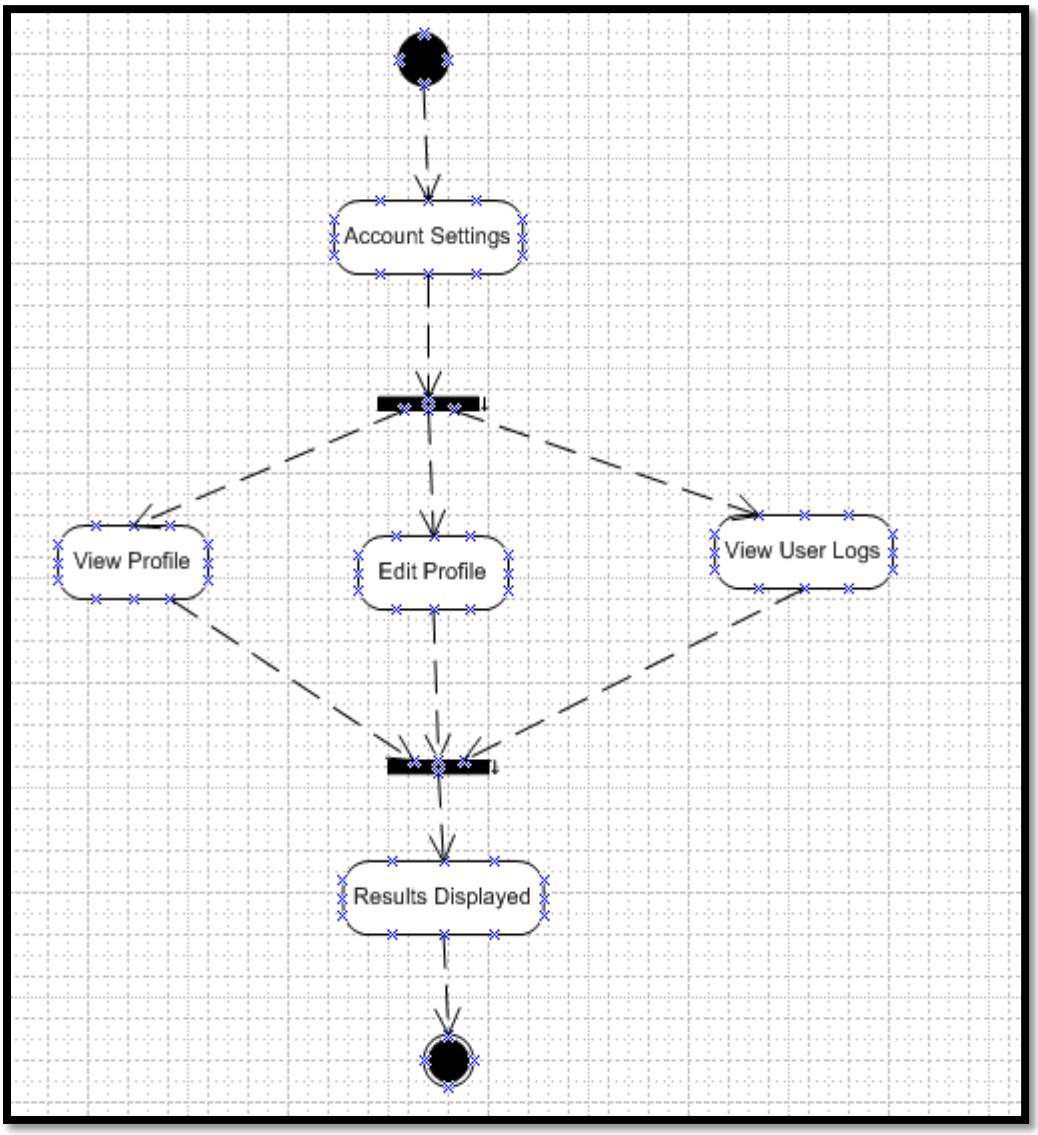

Figure 4.82 Account Settings Activity Diagram

Manage Vehicles

Figure 4.83 shows the activity diagram for managing the vehicles.

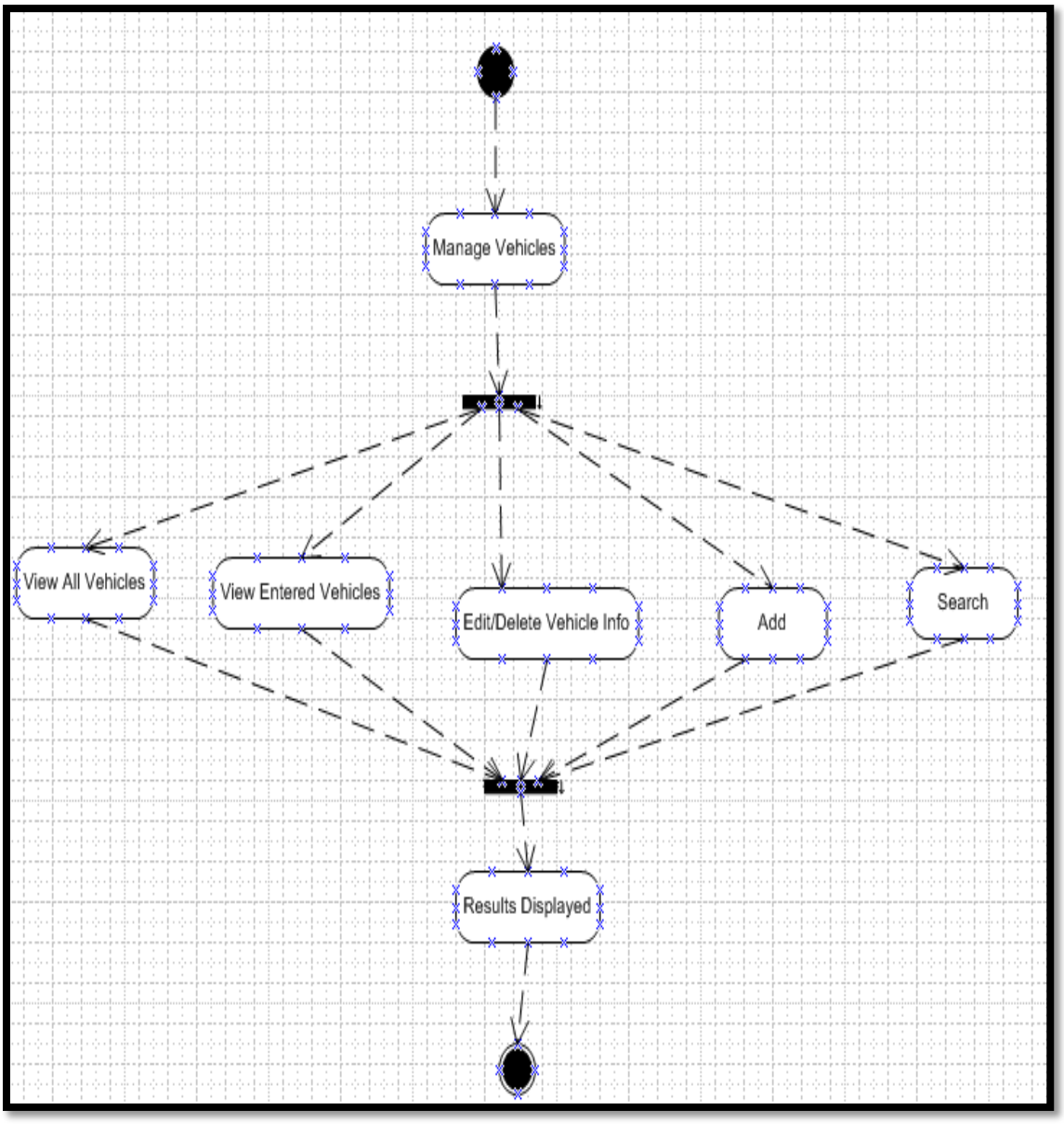

Figure 4.83 Manage Vehicles Activity Diagram

Add Vehicle

Figure 4.84 shows the activity diagram for adding a new vehicle.

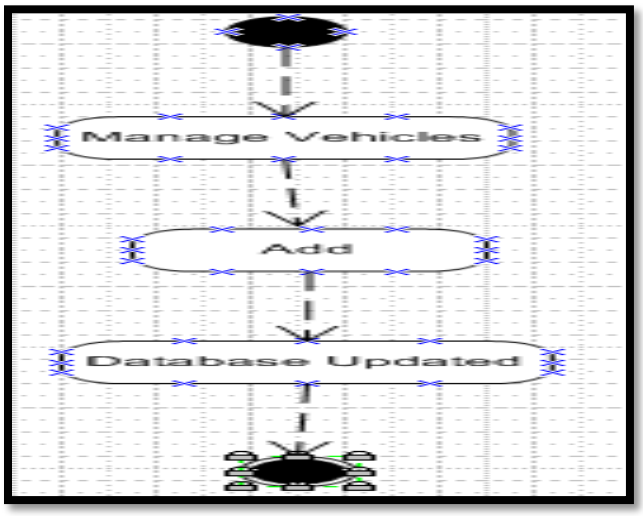

Figure 4.84 Add Vehicle Activity Diagram

Edit/Delete Vehicle Info

Figure 4.85 shows the activity diagram for editing or deleting vehicle information.

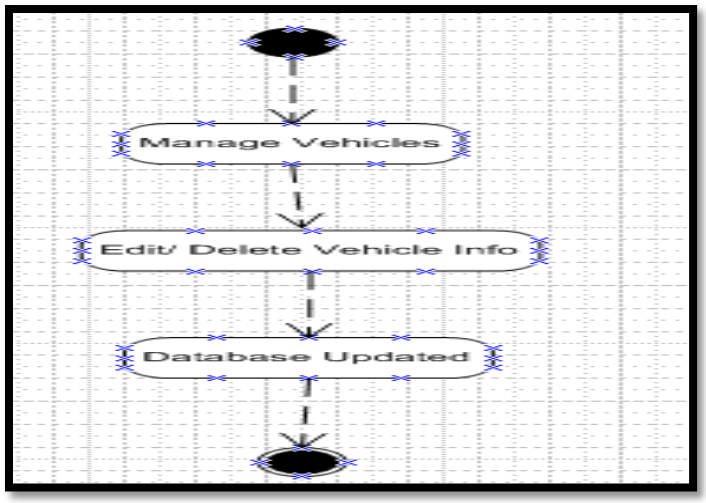

Figure 4.85 Edit/Delete Vehicle Activity Diagram

Search Vehicles

Figure 4.86 shows the activity diagram for vehicle search.

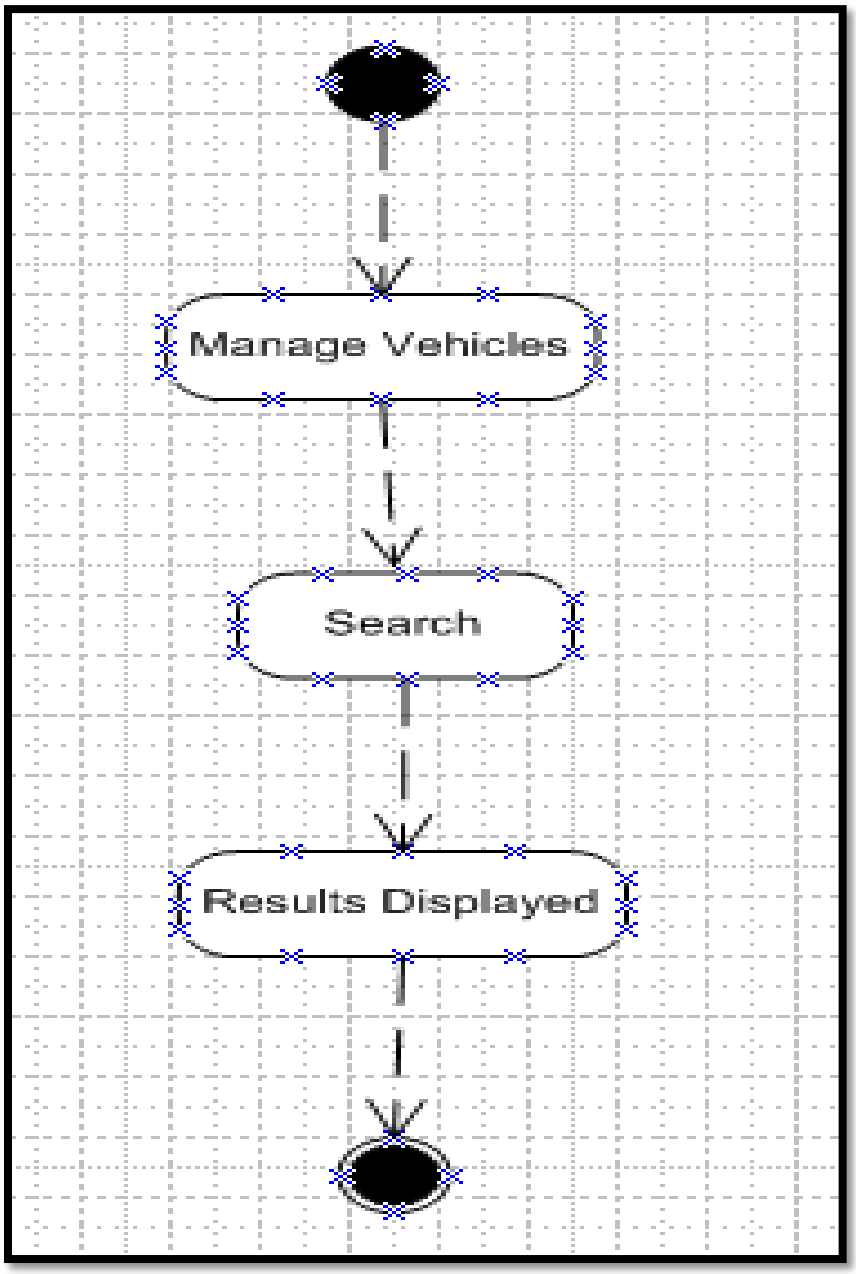

Figure 4.86 Search Activity Diagram

Manage Users

Figure 4.87 shows the activity diagram for managing the users.

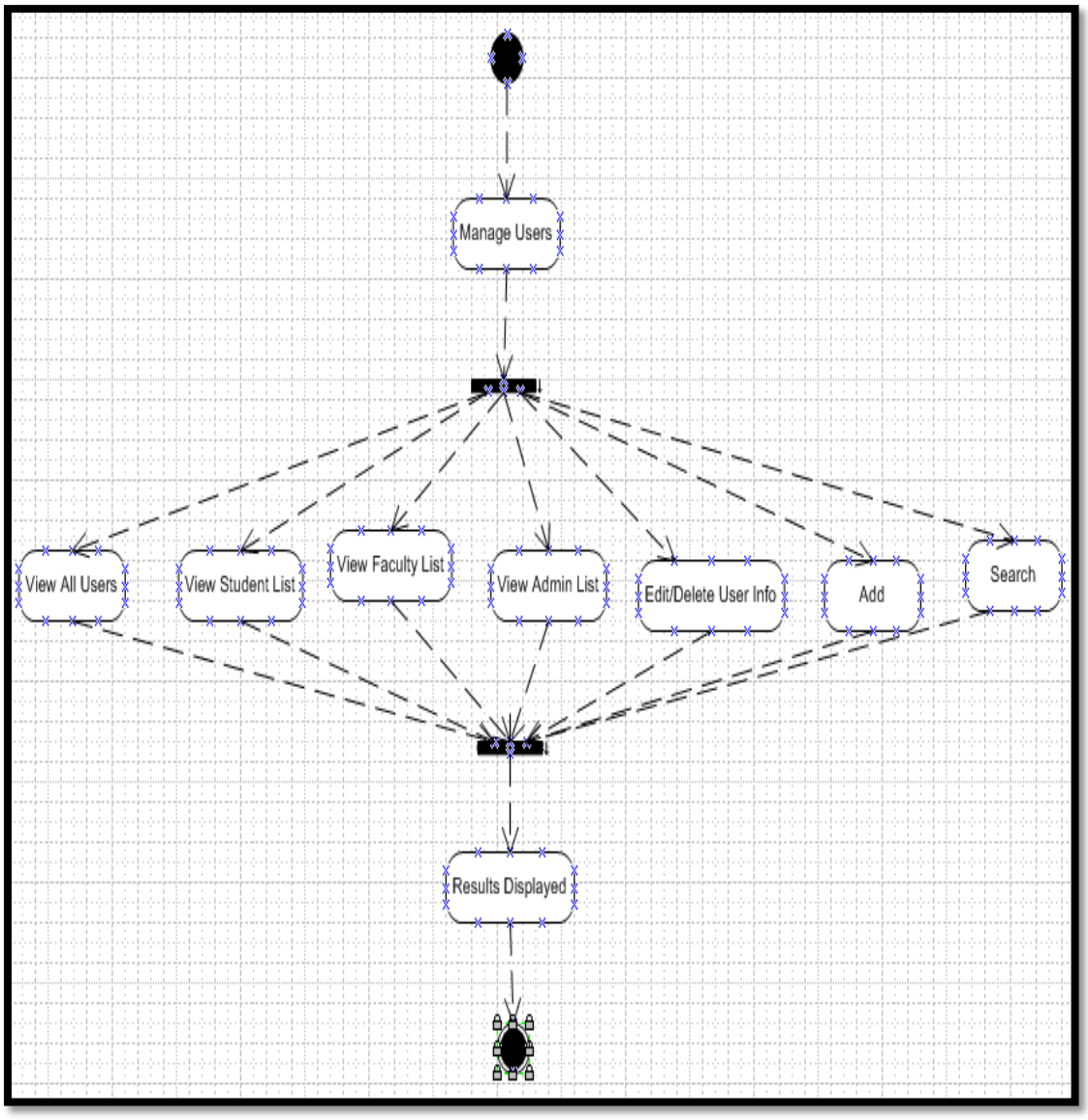

Figure 4.87 Manage Users Activity Diagram

Add User

Figure 4.88 shows the activity diagram for adding a new user.

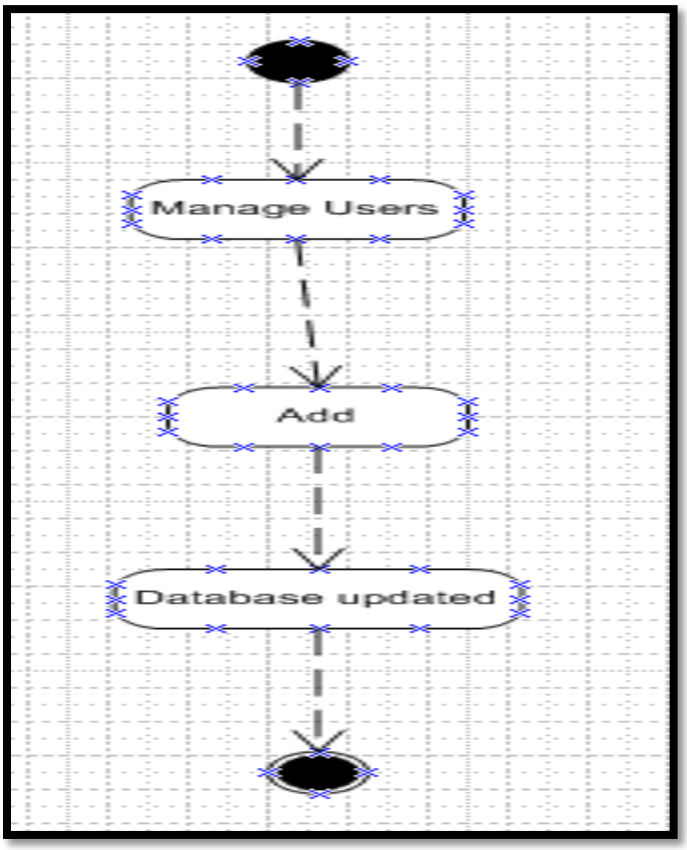

Figure 4.88 Add User Activity Diagram

4.2.5.3.2 Sequence Diagram

Sequence Diagrams are used to show the sequence of activities when a specific procedure is invoked.

Admin Login: Normal Case

Figure 4.89 shows the normal case for admin login into the system.

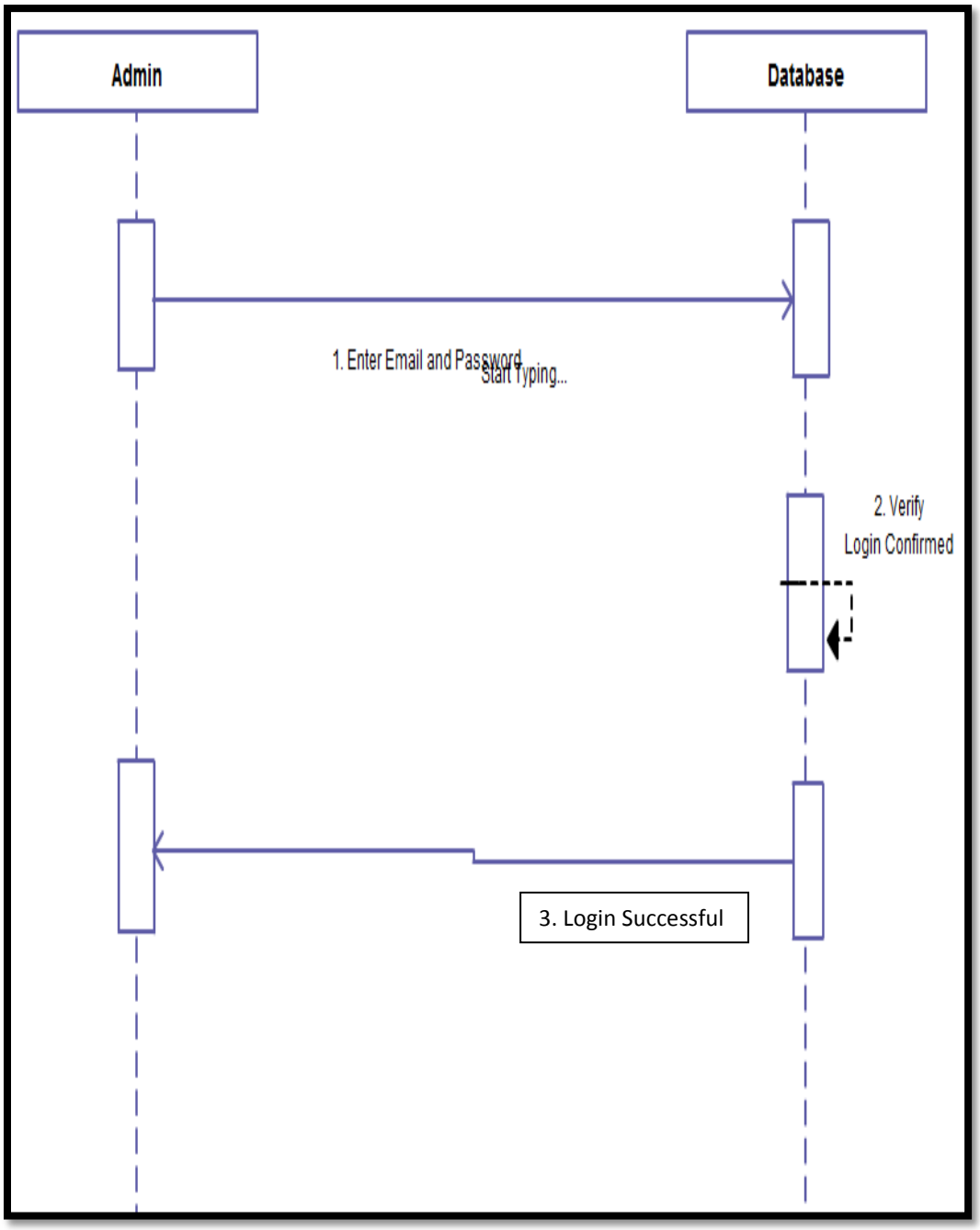

Figure 4.89 Admin Login Normal Case

Exceptional Case

Figure 4.90 shows the exceptional case for admin login into the system. Exceptional case means any case other than the normal way.

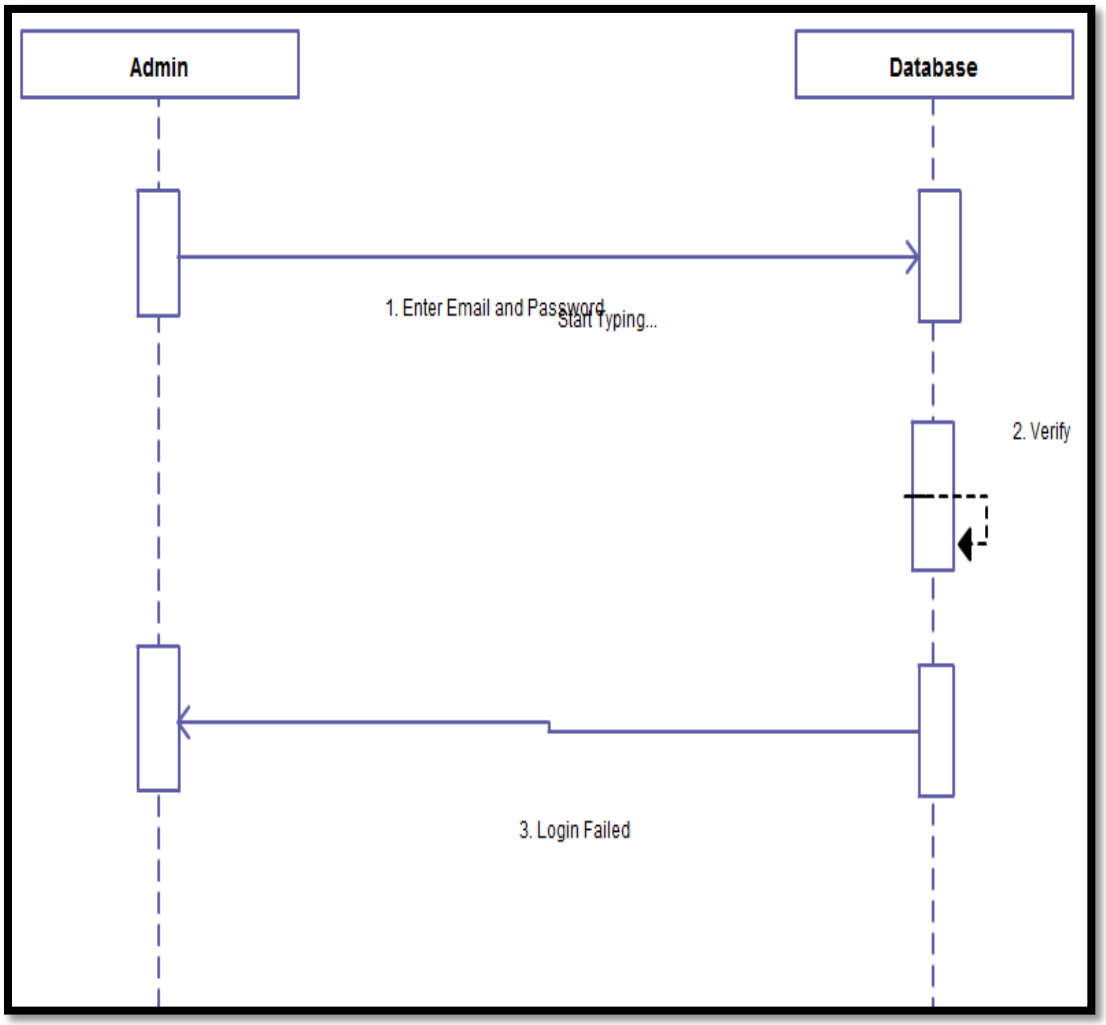

Figure 4.90 Login Exceptional Case

Search: Normal Case

Figure 4.91 shows the normal case for searching on the web portal.

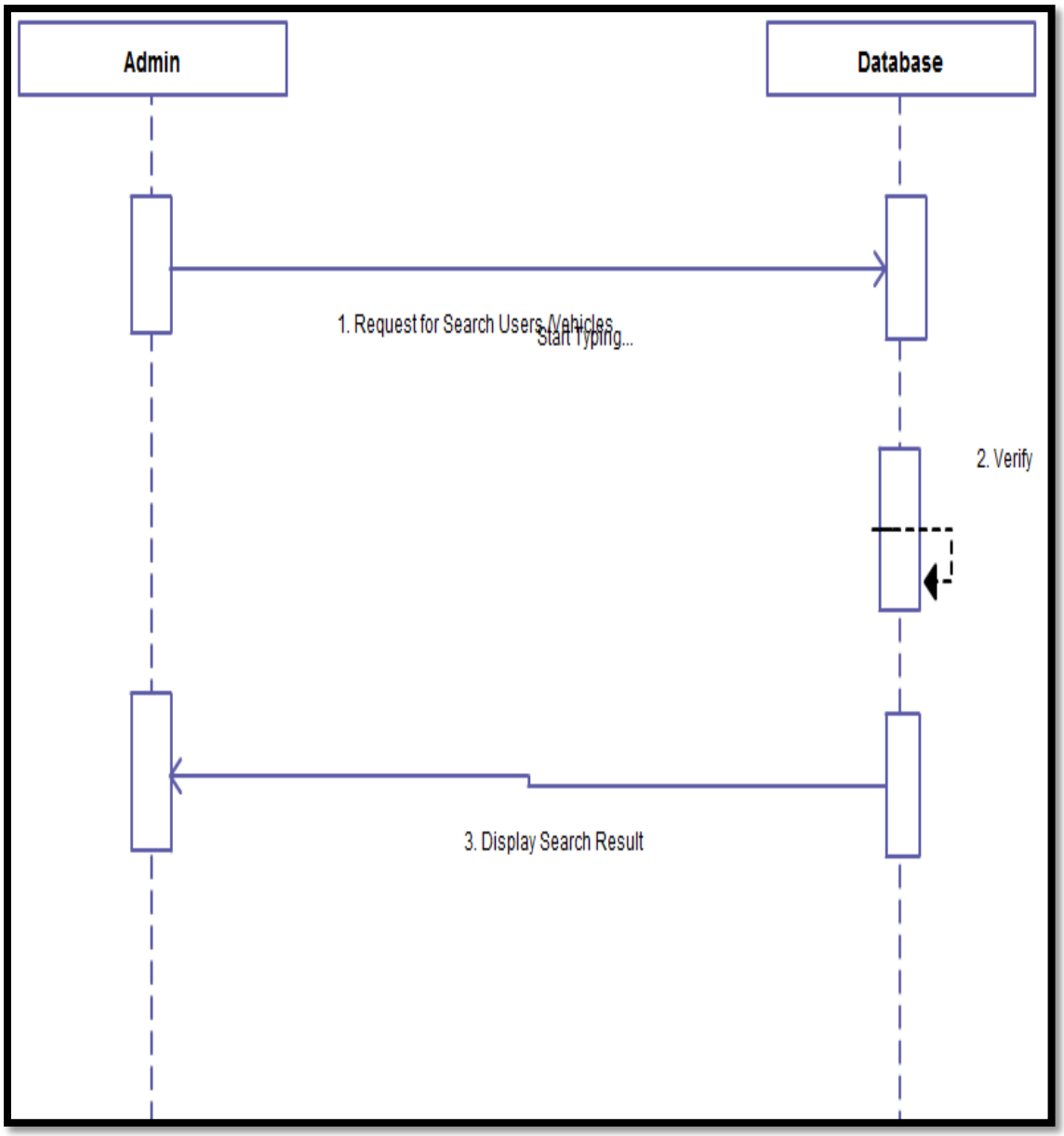

Figure 4.91 Search Normal Case

Exceptional Case

Figure 4.92 shows the exceptional case for admin login into the system.

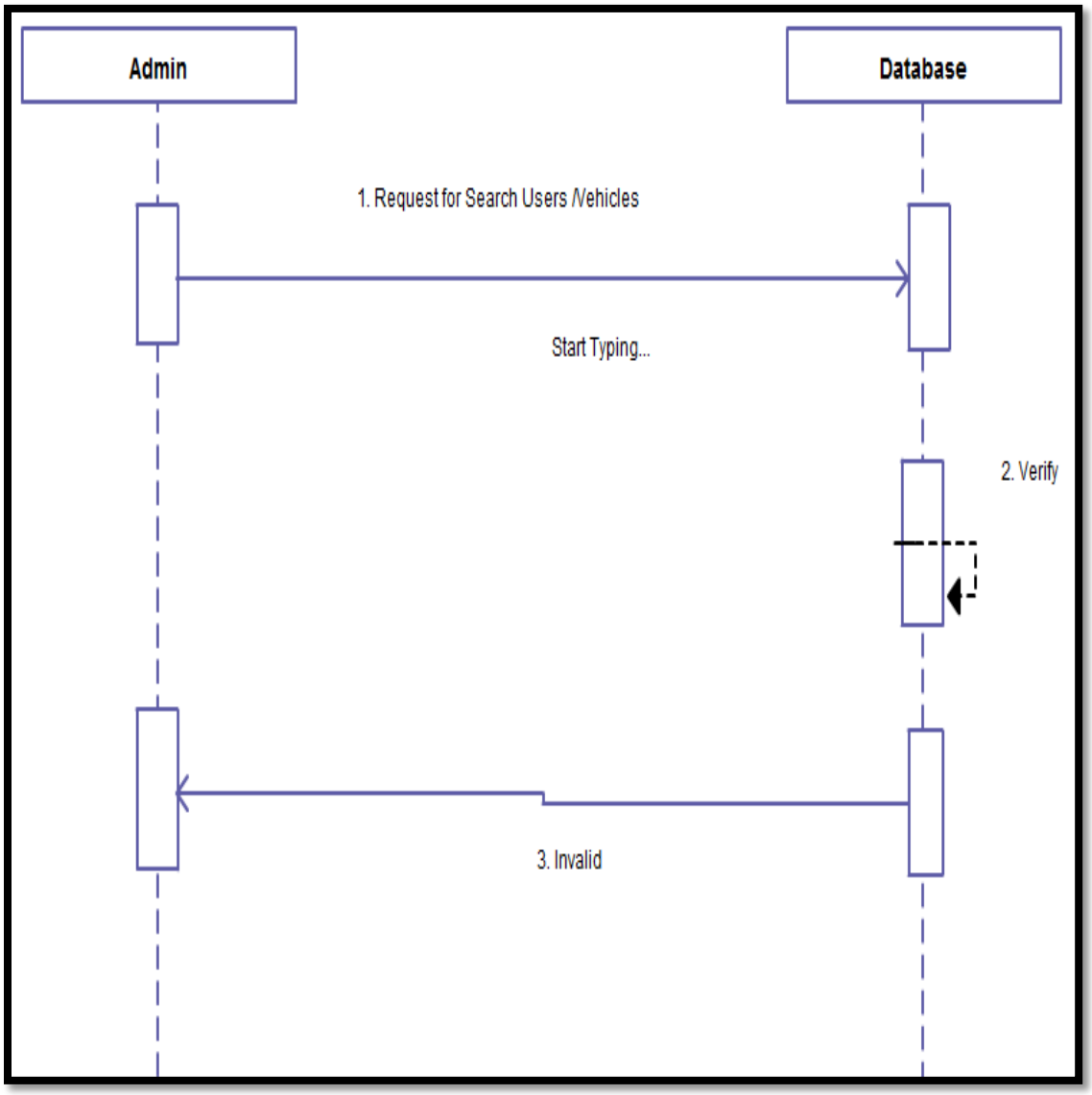

Figure 4.92Search Exceptional Case

Add New Vehicle / User

Figure 4.93 shows the case for adding new vehicle into the system.

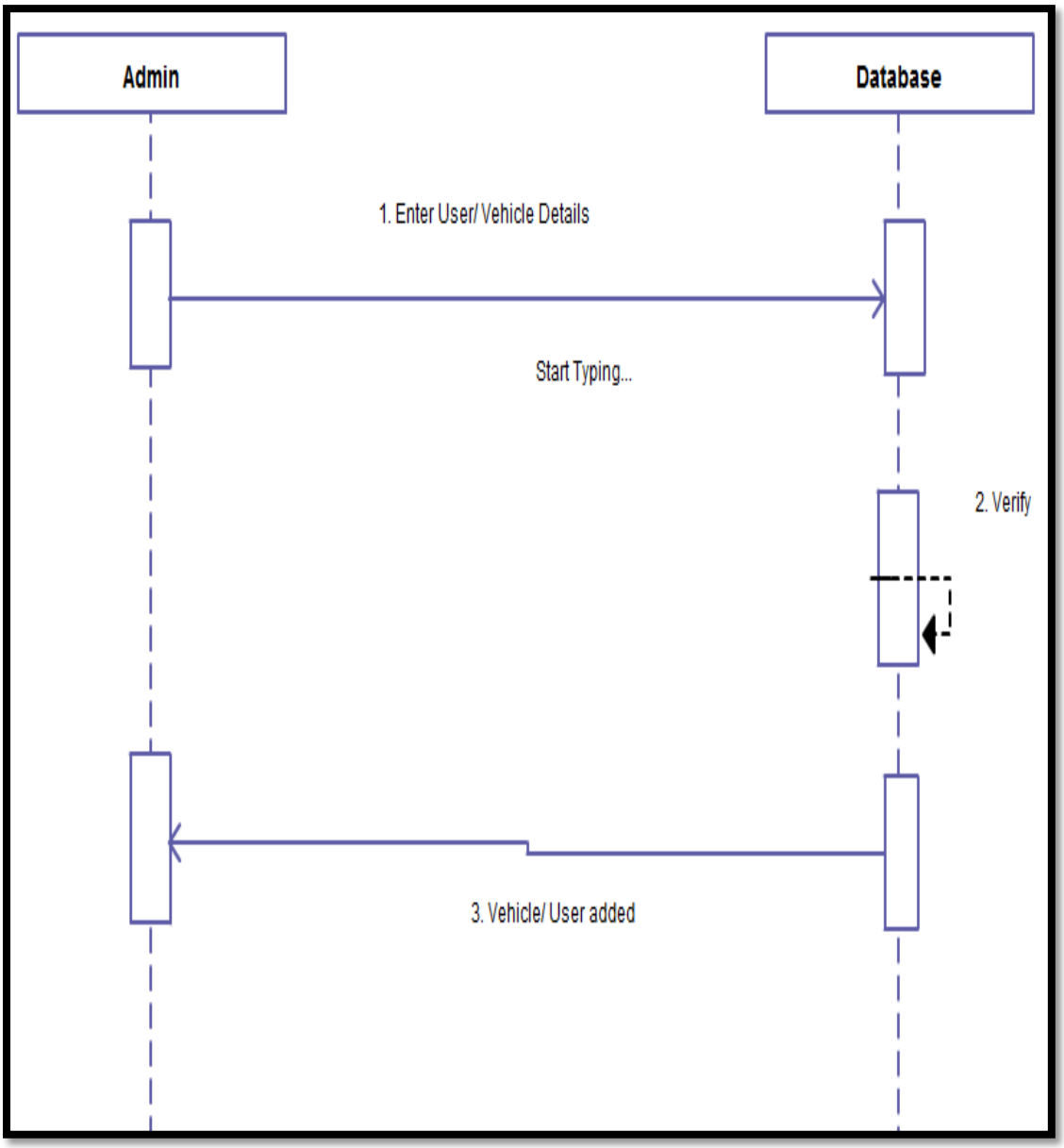

Figure 4.93 Add New Vehicle / User

Edit Vehicle/ User Info

Figure 4.94 shows the case for editing vehicle or user information..

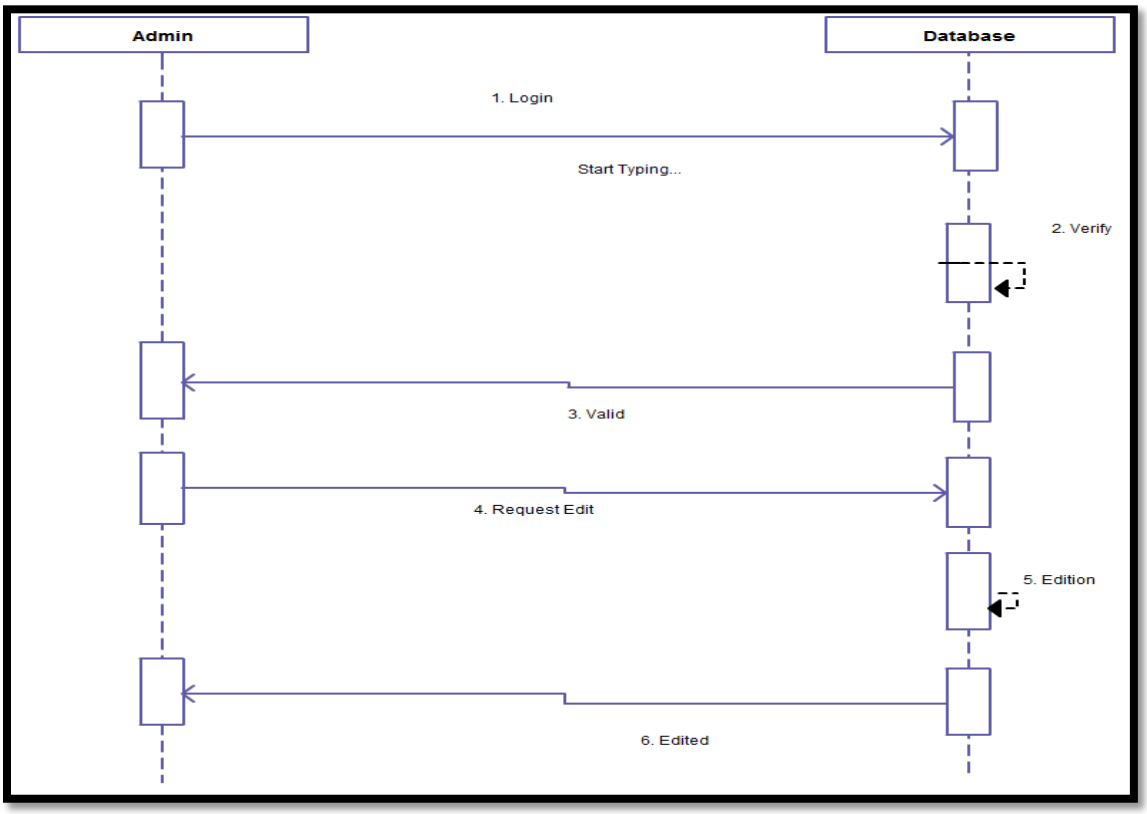

Figure 4.94 Edit Vehicle/User Info

4.2.5.4 Use Case Realization

Its purpose is to represent a graphical overview of the functionality provided by the system in terms of actors, their goals and dependencies between those use cases. The main purpose of use case diagram is to show what system functions are performed for which actor.

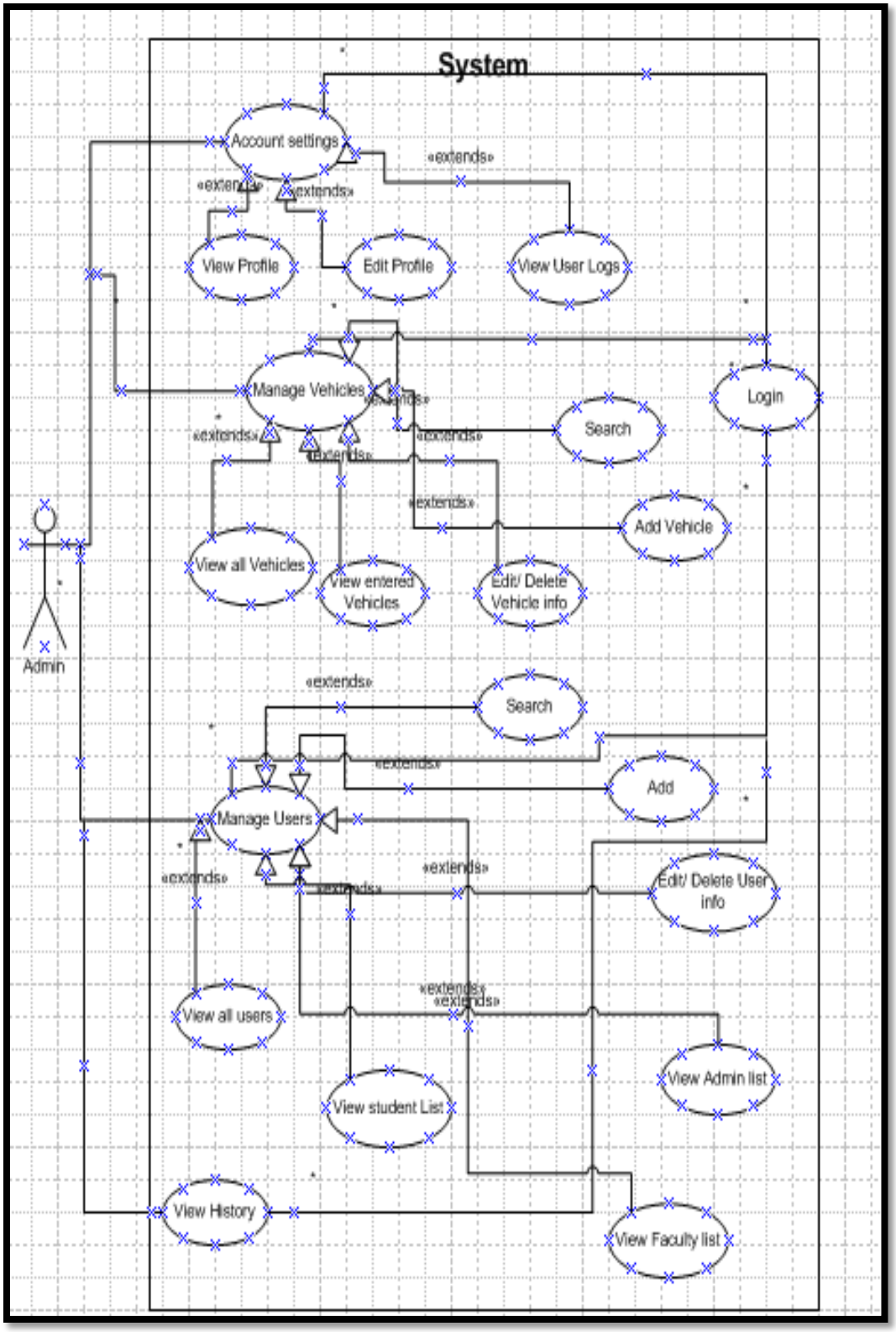

Figure 4.95 System Use Case Diagram

4.2.6 Implementation Document for Parking System

Physical Database Design

User's Record Table

This table consists of the following fields:

Fields	Data type
rfid_user	Varchar (244)
Name	Varchar (244)
Department	Varchar (244)
Course	Varchar (244)
CNIC	Varchar (244)
Email_Address	Varchar (244)

Password	Varchar (244)
Mobile_no	Varchar (244)
Address	Varchar (244)
Type	Varchar (244)
userpic	Varchar (244)

Table 4.3Users Record Table

The Table 4.8 will help to provide details about users who are registered into the system. It aids in displaying user details onto the web portal.

Login Table

This table consists of the following fields:

Fields	Data type
user	Varchar (244)
password	Varchar (244)
Email	Varchar (244)
rfid_user	Varchar (244)
rfid_vehicle	Varchar (244)

Table 4.9 Login Table

The Table 4.9 will help the users to log into the web portal. The type determines whether a student, faculty member or admin has logged in.

Vehicles Record Table

This table consists of the following fields:

Fields	Data Type
rfid_vehicle	Varchar (244)
Reg_no	Varchar (244)
Model	Int (10)
Type	Varchar (244)
Issue_Date	Date
Expiry_Date	Date
Make	Varchar (244)

Table 4.10 Vehicles Record Table

Log Files Table

This table consists of the following fields:

Fields	**Data Type**
rfid_user	Varchar (244)
rfid_vehicle	Varchar (244)
Entry_Date_Time	Datetime
Exit_Date_Time	Datetime
Total_Parking_Time	Time
Issue_Date	Date
Expiry_Date	Date

Table 4.4Log Files Table

The Table 4.11 maintains the details of the users and vehicles that have passed through the automated barrier. It will contain information that is necessary to keep track of various activities occurring.

4.2.6.1 Login to Desktop Application

When a user logs into the desktop application, an algorithm is followed this is as under:

4.2.6.1.1 Algorithm

Algorithm is a logical sequence that an activity follows when it is invoked. The flow diagram for login to desktop application is shown in the Figure 4.96

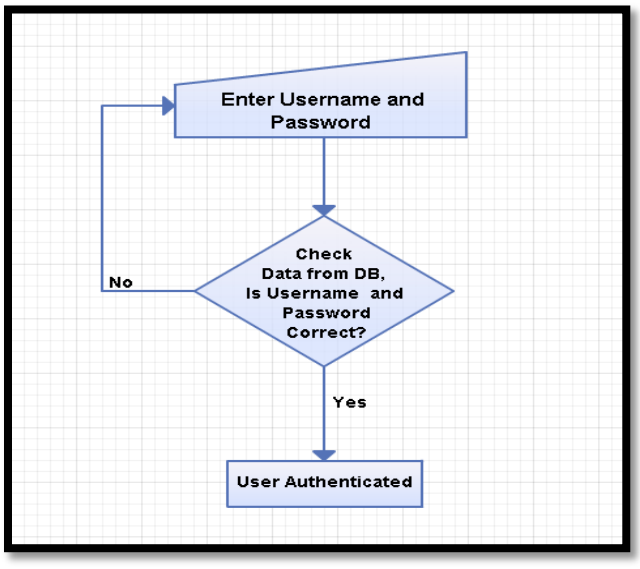

Figure 4.96 Flow Diagram to Login to Desktop Application

4.2.6.1.2 Code

```
string user;
string pass;

user = this.tb_user.Text;
pass = this.tb_pass.Text;

MySqlConnection conn = newMySqlConnection("Database = latest ; Server = localhost ;
Port = 3306 ; UserID = root");

string query = "SELECT * FROM user_record WHERE Email = " +"'" + user + "'" + "AND
password = " + "'" + pass + "'";

MySqlCommandcmd = newMySqlCommand(query, conn);
conn.Open();

MySqlDataReaderrdr = cmd.ExecuteReader();

while (rdr.Read())
            {
string username = (string)rdr["user"];
string password = (string)rdr["pass"];
user_db = username;
pass_db = password;

            }
rdr.Close();
```

```
conn.Close();
if (string.Compare(user_db, user) == 0 &&string.Compare(pass_db, pass) == 0)
            {
success = true;
            }
else
            {
success = false;
            }
```

4.2.6.2 Connection of System

When the system is turned on, connection is to be established with the reader.

4.2.6.2.1Algorithm

Algorithm is a logical sequence that an activity follows when it is invoked. The flow diagram for connection of system is shown in the Figure 4.97

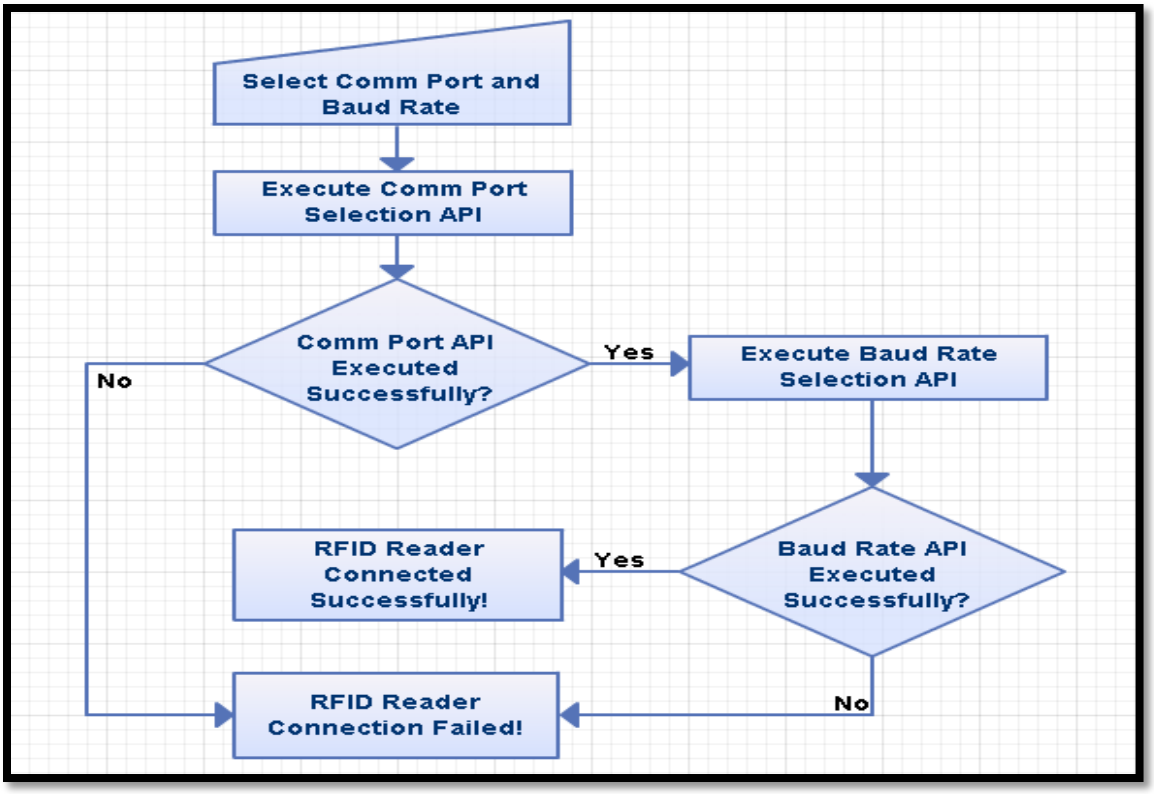

Figure 4.97 Flow Diagram of Connection of System

4.2.6.2.2 Code

```
privatevoidConnectButton_Click(object sender, EventArgs e)
      {
bytelinktype = 1;
stringcom_port = this.COMBox.Text; ;
byte ret = Demo.ReaderDll.OpenReader(refm_hCom, linktype, com_port);

if (ret == 0)
         {
stringnBaudStr = this.BaudBox.Text;
intnBaud = Convert.ToInt16(nBaudStr);
```

```
byte bret = Demo.ReaderDll.SetBaudRate(m_hCom, nBaud);


if (bret == 0)
            {
ConnLabel.Text = "Connection Successful!";
Thread t3 = new Thread(loop);
t3.Start();
            }
         }
else
         {
ConnLabel.Text = "Connection Failed!";

         }
      }
```

4.2.6.3RFID Parking System Algorithm

Parking management system has many functions and for their execution, an algorithm is needed.

4.2.6.3.1 Algorithm

The flow diagram for the parking system is shown in the figure 4.98

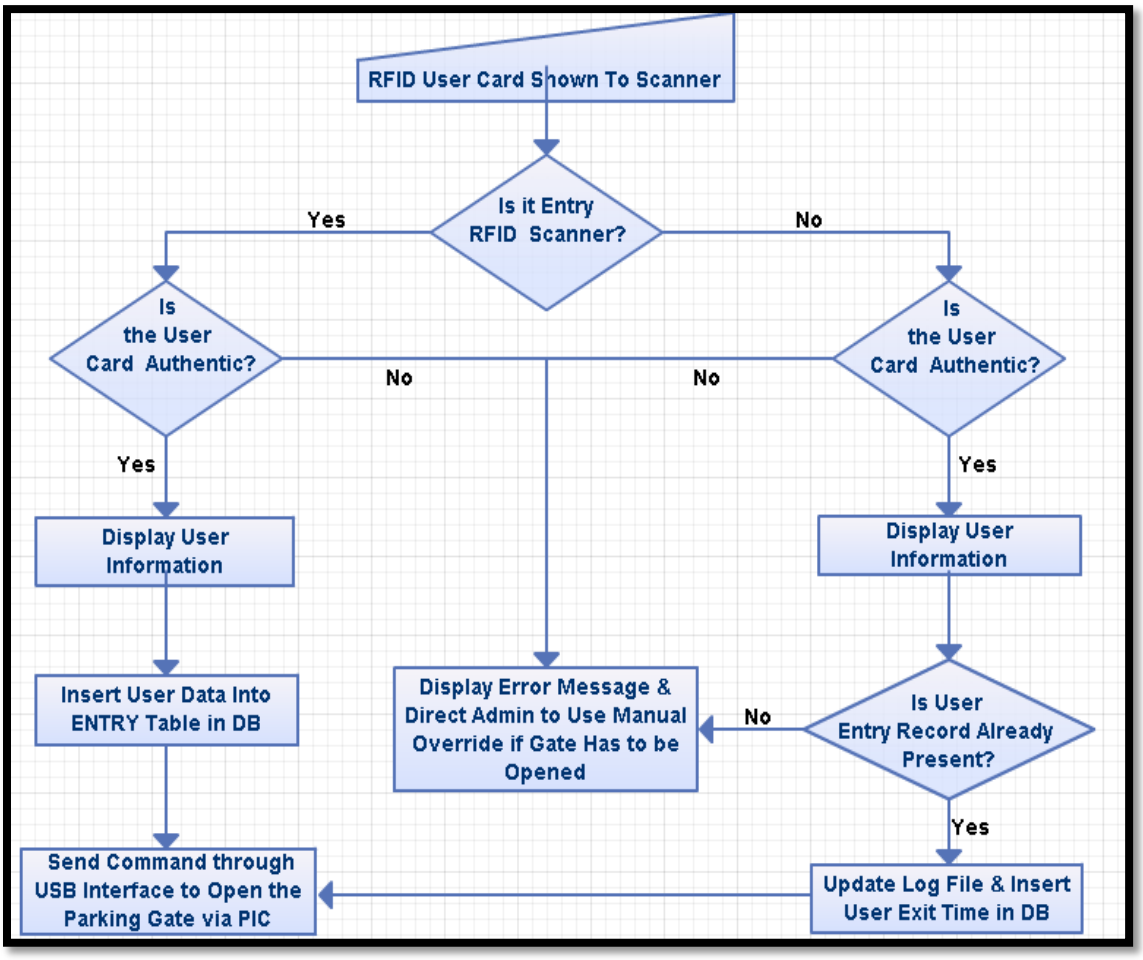

Figure 4.98 Flow Diagram of Algorithm of Parking System

4.2.6.3.2 Code

```
privatevoid loop()
      {
while (true)
```

```
        {
byte[] id;
byte[] temp1 = newbyte[12];
id = newbyte[15];
int count1 = 0;
bytenTagType = 4;
byteidenx;
byte[] t1 = newbyte[1];
idenx = 1;
idenx = Demo.ReaderDll.MultipleTagIdentifyEx(m_hCom, nTagType, ref count1, id);

if (idenx == 0)
          {
t1[0] = id[1];
string data = BitConverter.ToString(t1);
if (data == "01")
             {
int x = 0;
while (x <= 11)
                {
                   temp1[x] = id[x + 3];
x++;
                }

                RFIDIP = BitConverter.ToString(temp1);

MySqlConnection cs2 = newMySqlConnection("Database = parking ; Server = localhost ;
Port = 3306 ; UserID = root");
```

```
MySqlCommandcmd;
MySqlDataReaderrdr;

string query = "SELECT Name, Department, CNIC, Course, Mobile_no, Type FROM
users_record WHERE rfid_user = " +"'" + RFIDIP + "'";
cs2.Open();
cmd = newMySqlCommand(query, cs2);
rdr = cmd.ExecuteReader();
while (rdr.Read())
                {
MessageBox.Show("Antenna Reading!");
name = (string)rdr["Name"];
LBL1visible();
department = (string)rdr["Department"];
                    CNIC = (string)rdr["CNIC"];
course = (string)rdr["Course"];
mobile = (string)rdr["Mobile_no"];
type = (string)rdr["Type"];
                }
LBL1visible();
LBL2visible();
LBL3visible();
LBL4visible();
LBL5visible();
LBL6visible();

cs2.Close();
```

```
MySqlConnectioncs = newMySqlConnection("Database = parking ; Server = localhost ;
Port = 3306 ; UserID = root");
MySqlCommand cmd1;
MySqlDataReader rdr1;

string query1 = "Update log_files Set Exit_Date_Time = current_timestamp WHERE
rfid_user = " +"'" + RFIDIP + "'";
cs.Open();
                    cmd1 = newMySqlCommand(query1, cs);
                    rdr1 = cmd1.ExecuteReader();
cs.Close();

theReferenceUsbDevice.testUp();



                }

if (data == "02")
                {
int x = 0;
while (x <= 11)
                   {
                      temp1[x] = id[x + 3];
x++;
                   }

                   RFIDIP = BitConverter.ToString(temp1);
```

```
stringconnstring = "Server=localhost; Port=3306; Database=parking; Uid=root;
password=";

MySqlConnection conn = newMySqlConnection(connstring);
MySqlCommand command = conn.CreateCommand();

conn.Open();

command.CommandText = "SELECT Name, Department, CNIC, Course, Mobile_no, Type
FROM users_record WHERE rfid_user = '" + RFIDIP + "' ";
MySqlDataReaderrdr = command.ExecuteReader();

while (rdr.Read())
            {

name = rdr["Name"].ToString();
LBL1visible();
department = (string)rdr["Department"];
                    CNIC = (string)rdr["CNIC"];
course = (string)rdr["Course"];
mobile = (string)rdr["Mobile_no"];
type = (string)rdr["Type"];
                }

if (name != "")
                 {
LBL1visible();
```

```
LBL2visible();
LBL3visible();
LBL4visible();
LBL5visible();
LBL6visible();

conn.Close();

MySqlConnection cs3 = newMySqlConnection("Database = parking ; Server = localhost ;
Port = 3306 ; UserID = root");
MySqlCommand cmd2;

string query2 = "Insert into log_files Set rfid_user= " +"'" + RFIDIP + "',
Entry_Date_Time = current_timestamp";
cs3.Open();
                    cmd2 = newMySqlCommand(query2, cs3);
MySqlDataReader rdr2;
                    rdr2 = cmd2.ExecuteReader();
cs3.Close();

theReferenceUsbDevice.testUp();
                }


            }
        }
    }
}
```

CHAPTER 5

SYSTEM INTEGRATION AND TESTING

5.1 Integration of Hardware and Software

The hardware of the project consists of RFID tag, RFID reader and the circularly polarized antenna while the software part consists of the desktop application, the database and the online portal.

Following are the steps in which both the parts communicate with each other to make a complete system. Whenever the tag comes in the vicinity of the circularly polarized antenna, it is powered up by the signal from the antenna and sends specific information (ID) to the antenna as shown in the Figure 5.1

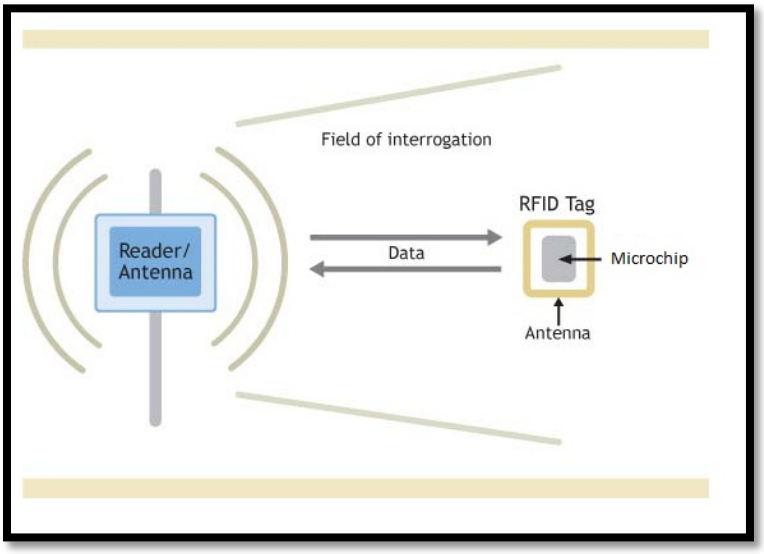

Figure 5.1 Data Transmission between Reader and Tag

The antenna transfers the tag code to the RFID reader board. The RFID board recognizes this received code.The reader then sends this information via USB to the host system where the

desktop application reads it and transfers it to the MySql database hosted on the WAMP Server where the data is stored and can be accessed via the online portal. This is shown in the Figure 5.2

Figure 9 Data Transmission between Reader and Desktop Application

5.2 Testing

The testing of the hardware and the complete project was conducted in different phases. Here is a brief description. After the fabrication of the scanning antenna, it was tested using **Agilent 8714ET** Vector

Network Analyzer (VNA) to ensure that it is operating as desired. The following results were obtained which were compliant with the results mentioned in the IEEE paper from which the design of the antenna was taken. Figure 5.3 shows the image of the fabricated antenna being tested.

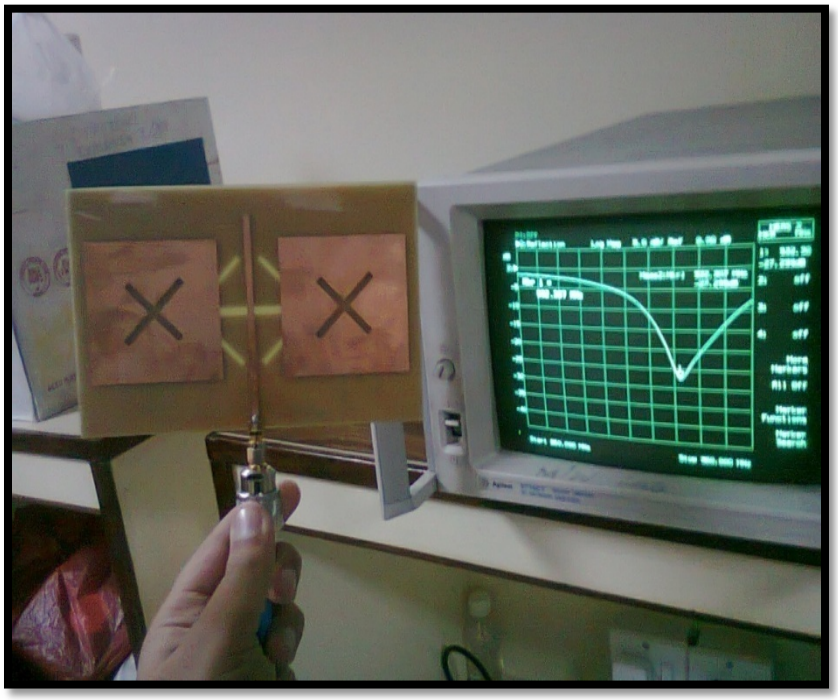

Figure 10 Antenna Connected to VNA

VNA Result: Reflection Coefficient (S11)

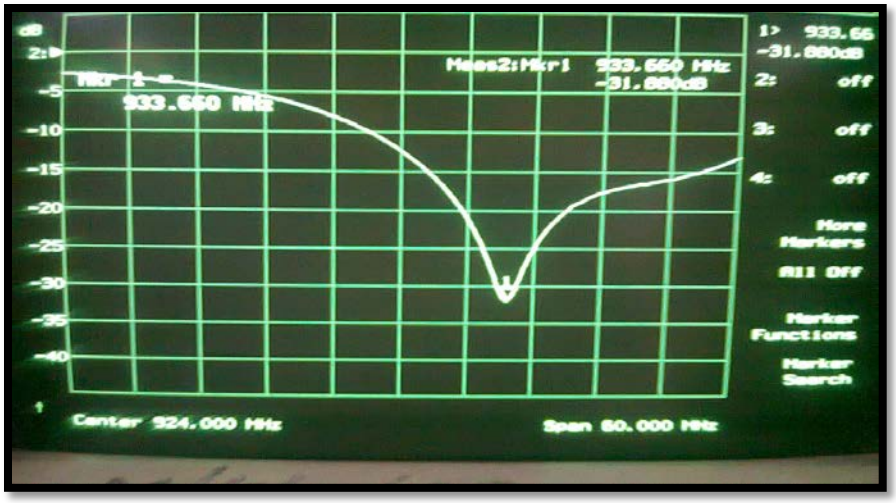

Figure 11 Reflection Co-efficient (S11)

A dip of -31 dB is obtained at 930 MHz as shown in Figure 5.4. For an antenna to resonate properly at the desired frequency, the S11 dip at that frequency should be less than -10 dB.

VNA Results: Z_o

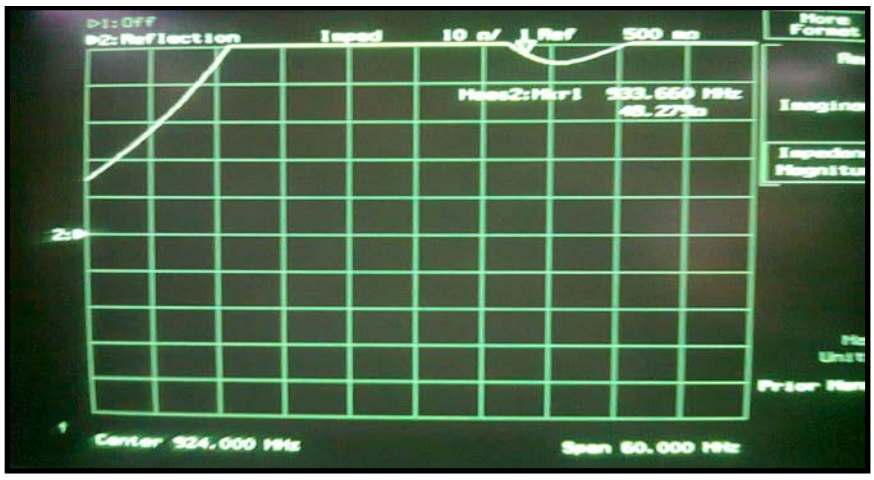

Figure 12Port Impedance (Zo)

Zo is the characteristic impedance of the antenna and for matching purposes, the Zo of the microstrip line should be the same as the input impedance of the antenna. Zo is either 50 ohms or 75 ohms. Our experimental result shows that Z0 is approximately 50 ohms.

Next step was to test the reading range and circular polarization of the antenna. The antenna can read the tags upto 2-3 feet and in any orientation. In a metallic environment, the reading capability of the antenna is greatly affected.The rfid board is not suitable for use in hot environment.The hardware and the software were integrated and run end-to-end to ensure proper working of the system.

5.3 Conclusion

By the use and implementation of the RFID technology that is currently one of the largest growing technologies, we have automated many tasks that would otherwise require a lot of workforce and hence increase the cost thereby reducing effectiveness. We have therefore designed a system that would provide efficiency, security and would save a lot of time. By using RFID technology in Library management and security, and in the automated parking system, it provides benefit to ends, the administrators and members. By the use of this relatively

new technology, human error has been considerably reduced and the effort required in many tasks has been almost nullified.

Since both the systems are automated, the time for minor tasks that would otherwise be time consuming would be done in a matter of seconds and with effectiveness. Since we have developed a multipurpose system, it is truly generic in the sense that any other system or service can be implemented with minimal hardware and software changes.

The RFID technology is being implemented all over the world due to its efficiency and flexibility not to mention minimal human involvement in the systems. Slowly such a system can be devised where a single user card is used for all purposes within a facility by centralizing the control and database management

Appendix A

PHYSICAL DATABASE DESIGN FOR LIBRARY MANAGEMENT SYSTEM

Users Record Table

RFID_Id: This field contains the RFID numbers of users

Name: It contains the names of the users

Reg_Num: It contains the university registeration numbers of the users

Department: It contains the department of the registered users i.e. EE, CS, IS

Course: It contains the course numbers of the student e.g. TE-47 A

Email: It specifies the email addresses of the users

Mobile_No: It contains the mobile numbers of the users

Address: It contains the addresses of the users

Fine: This field contains the value of fine for the users who have not returned the book in time

Fine List Table

Amount: It contains the amount of fine in rupees for overdue books. This amount is calculated by multiplying the overdue days witht the fine per day (Rs. 3)

Return_Date: It specifies the expected return date of the book

RFID_id_Books: It conatins the rfid number of the book that has not been returned

Reserved Books List Table

Res_Num: It specifies the number of books reserved by the user

Res_Date: It specifies the date on which the books are reserved. It is important as students are allowed to reserve a book and then get it

issued within 24 hours. If they are unable to do so, then their reservation is automatically cancelled

Issued Books List Table

I_User: It contains the rfid number of the user who has issued a book

Issue_date: It specifies the date of issue of a book

I_time: It contains the time of issue of a book

R_time: It contains the time of return of the issued book

ER_Date: It specifies the expected return date of the issued book

OD_Date: It conatins the overdue date of an issued book if it is not returned on the expected date of return

Books List Table

Y_Pub: It contains the year of publication of a book

B_Price: It contains the price of the book at which it is bought

B_From: It specifies the book shop from where the book is bought

Add_Dates: It contains the date of addition of a book in the database

Rem_Dates: It specifies the date of removal of a book from the database

Rem_Reasons: It specifies the reason of removing a book from the database (theft etc)

Keywords: It contains the keywords that can be used to search the book on the web portal

I_Allowed: It specifies whether the book is allowed for issue or not

I_Bits: If this bit is 1, it means that the book is issued. If it is 0, it means that the book is available for issue

T_Bits: It this bit is 1, it means the book has been stolen

Log Files Table

I_Date: It specifies the date of issue of a book

R_Date: It specifies the expected date of return of a book which is issued

O_Days: It specifies the number of overdue days

Appendix B

PHYSICAL DATABASE DESIGN FOR PARKING SYSTEM

Users Record Table

rfid_user: It contains the rfid number of the registered user

rfid_vehicle: It contains the rfid number of the registered vehicle

Login Table

user: It contains the username of users

Vehicles Record Table

Reg_no: It contains the registeration numbers of vehicles

Type: It specifies whether the vehicle is a car or a bike

Issue_Date: It specifies the date of issue of the rfid tag to a user

Expiry_Date: It specifies the expiry date of the rfid tag. The tag expires when a student leaves the university after completion of studies

Make: It specifies the make of the vehicle e.g. Honda, Suzuki etc

Log Files Table

Entry_Date_Time: It specifies the date and time of entry of a vehicle

Exit_Date_Time: It specifies the date and time of exit of a vehicle

Appendix C

CODE AND COMPILER FOR PROGRAMMING PIC MICROCONTROLLER

In-order to program the microcontroller that has been used in the parking module, we used MikroC compiler for PIC because of its vast library of inbuilt functions and its ease of use. The microcontroller employed in the module is performing the three basic functions in the system as explained in the previous topics.Establishing serial communication with the host system, controlling the mechanical gate through the L293D motor driver IC and displaying the status of the gate with the help of LEDs.

For all of the above functions the code along with the comments is given below:

```
#include "lcdConfig.h"          // LCD Initialization done through a
source file

sbit enable at RD0_bit;         // Initial declarations for microcontroller
pins
```

```
sbit up at RD1_bit;
sbit down at RD2_bit;
sbitledup at RD3_bit;
sbitleddown at RD4_bit;
sbit sensor1 at RD5_bit;
sbit sensor2 at RD6_bit;
sbitup_direction at TRISD1_bit;             //Setting Tristate Buffers for
Input/Output
sbitdown_direction at TRISD2_bit;
sbit sensor1_dir at TRISD5_bit;
sbit sensor2_dir at TRISD6_bit;

unsigned char readbuff[2] absolute 0x500;             // Buffers are in
USB RAM, From Data sheet
unsigned char writebuff[2]  absolute 0x540;

unsigned char output[1];
unsigned inti = 0;

void interrupt()                // This part is to enable the interrupt for
USB communication
{                               // So whenever host system communicates
```

```
with PIC microcontroller
    if(USBIF_bit)                // an interrupt enables the USB
servicing.
    {
USBIF_bit = 0;
USB_Interrupt_Proc();
    }
}

void main()              // The main part of code start from here
{
 ADCON1 = 0x0F;
 TRISB = 0x00;
 TRISA = 0x00;
 TRISD = 0x00;
 PORTD = 0;
Lcd_Init();                      // LCD Initializations and commands
Lcd_Cmd(_LCD_CLEAR);
Lcd_Cmd(_LCD_CURSOR_OFF);
Lcd_Out(1, 1, "Welcome");
Delay_ms(2000);
Lcd_Cmd(_LCD_CLEAR);
```

```
enable = 1;
 for(i=0;i<4;i++)                    // Loop is used to check correct
working of code
     {
leddown = 0;
ledup = 1;
Delay_ms(1000);
leddown  = 1;
ledup = 0;
Delay_ms(1000);
     }
ledup = 0;
leddown = 0;

HID_Enable(&readbuff, &writebuff);        // Enable HID communication
 while(1)
 {
 sensor1_dir = 1;
 sensor2_dir = 1;
 while(HID_Read())                   // When USB communication is
enabled, this loop is executed
 {
```

```
Lcd_Out(1, 1, "inside HID_Read");
Delay_ms(1000);
Lcd_CMD(_LCD_CLEAR);


 switch (readbuff[0])
      {
      case 0x80:                    // If hex code 0x80 is received
from host system execute case
      {
            for(i=0;i<5;i++)            // Code to enable opening of
the door
            {
up_direction = 0;
down_direction = 0;
            up = 1;
            down = 0;
ledup = 1;
leddown = 0;
Delay_ms(1000);
            }
Lcd_Out(1, 1, "PLEASE PROCEED");
            up = 0;
```

```
Delay_ms(4000);
Lcd_CMD(_LCD_CLEAR);
Lcd_Out(1, 1, "Time Remaining");
                for(i=0;i<5;i++)
                                {
                                if(i==0)
                                  {
Lcd_Out(2, 1, "5");
                                  }
                                if(i==1)
                                  {
Lcd_Out(2, 1, "4");
                                  }
                                if(i==2)
                                  {
Lcd_Out(2, 1, "3");
                                  }
                                if(i==3)
                                  {
Lcd_Out(2, 1, "2");
                                  }
                                if(i==4)
```

```
                        {
Lcd_Out(2, 1, "1");
                        }
Delay_ms(980);
Lcd_CMD(_LCD_CLEAR);
Lcd_Out(1, 1, "Time Remaining");
                       }
Lcd_CMD(_LCD_CLEAR);
            break;
            }
case 0x81:                  // Case for closing of door
    {
for(i=0;i<5;i++)
            {
up_direction = 0;
down_direction = 0;
            up = 0;
            down = 1;
ledup = 0;
leddown = 1;
Lcd_Out(1, 1, "DOOR CLOSING");
Delay_ms(1000);
```

```
            }
            down = 0;
Lcd_CMD(_LCD_CLEAR);
            break;
            }
      }
 }
up_direction = 1;                    // This part of code is for manual
override of door
down_direction = 0;
while(up==1)
       {
       while(sensor1 == 1)
          {
           down=1;
Lcd_CMD(_LCD_CLEAR);
Lcd_Out(1, 1, "Door Opened");
Delay_ms(1000);
          }
Lcd_CMD(_LCD_CLEAR);
Lcd_Out(1, 1, "Manual Overide up");
ledup =1;
```

```
leddown = 0;
Delay_ms(1000);
        }
Lcd_Cmd(_LCD_CLEAR);
 down = 0;


down_direction = 1;
up_direction = 0;
while(down==1)
        {
        while(sensor2 == 1)
           {
            up=1;
Lcd_CMD(_LCD_CLEAR);
Lcd_Out(1, 1, "Door Closed");
Delay_ms(1000);
           }
Lcd_CMD(_LCD_CLEAR);
Lcd_Out(1, 1, "Manual Overide down");
ledup =0;
leddown = 1;
```

```
Delay_ms(1000);
        }
Lcd_CMD(_LCD_CLEAR);
 up = 0;
 }
}
```

REFERENCES

[1] IEEE paper 'Adjustable axial ratio of single-layer circularly polarized path antenna for portable RFID reader' by Y.-F. Lin,H.-M. Chen,S.-C. Pan, Y.-C .Kao and C.-Y. Lin

[2] Product details, http://rfid-nfc.en.made-in-china.com/product/IbPJZOAVkMWd/China-UHF-RFID-Reader-Module-NFC-9802M-.html

[3] Product details, http://www.gongchang.com/RFID_Inlay_NFC_964-dp11984713/

[4] MICROCHIP- PIC 18F4550 Microcontroller Data sheet.

[5] SGS THOMSON MICROELECTRONICS- L293D Data Sheet